

Miscellaneous Publication No. 12

THE GENUS PHYTOPHTHORA

DIAGNOSES (OR DESCRIPTIONS)
AND FIGURES FROM THE ORIGINAL PAPERS

Compiled by
GRACE M. WATERHOUSE



THE COMMONWEALTH MYCOLOGICAL INSTITUTE

KEW, SURREY 1956

Price 15s 0d net



Miscellaneous Publication No. 12

THE GENUS
PHYTOPHTHORA

DIAGNOSES (OR DESCRIPTIONS)
AND FIGURES FROM THE ORIGINAL PAPERS

Compiled by
GRACE M. WATERHOUSE

THE COMMONWEALTH MYCOLOGICAL INSTITUTE

KEW, SURREY 1956

THE GENUS PHYTOPHTHORA

Diagnoses (or descriptions) and figures from the original papers

Compiled by Grace M. Waterhouse
Commonwealth Mycological Institute

The object of this compilation is to put before students of the genus Phytophthora the original diagnoses (or a selected basic description if no diagnosis was given), with reproductions of the associated figures, of all the species that have, at some time or other, been placed in the genus or in genera considered synonymous with it. These descriptions have been collected from the original sources over a number of years, many of them from publications not readily accessible. It was felt that all this information would be useful to many workers concerned with this important genus, who are perhaps unable to embark on the time-consuming task of searching the literature for all the known species.

The information is given without comment, the object being to provide the data and not to make a critical review. Every specific epithet that has ever been attached to Phytophthora, as far as I have been able to determine, is included, but only obligate synonyms are indicated. Names which may be unwanted are included for citation in proposed lists of facultative synonyms.

The diagnoses (or descriptions) are quoted in the language used in the original paper, except those in Japanese. Where a translation was not given in the original a fairly literal one has been appended in square brackets. Original figures made from line drawings have been reproduced by photostat; half-tone plates have been photographed.

I should like to thank all those who have assisted in this project, particularly the editorial boards of the various journals for permission to reproduce the figures; to the Royal Botanic Gardens, Kew, for the loan of books, most of them precious; to Professor T. Matsumoto, Dr. C. T. Wei, and Dr. Z. Hidaka for providing the translations from the Japanese; and to members of the staff of the Commonwealth Mycological Institute who assisted with some of the other translations, provided the photostat copies of the figures, and made the final typed draft for lithoprinting.

THE GENUS

PHYTOPHTHORA de Bary in J. R. agric. Soc., 12 (Ser. 2, 1), p. 240, (December 1875) 1876.

Type species Phytophthora infestans (Montagne) de Bary.

The characters derived from the structure of the conidiophores divide the Peronosporae generally into two, perhaps better into three, genera, Cystopus, Peronospora, and a third, which may be called Phytophthora.

Phytophthora is distinguished from Peronospora in having not one but several conidia successively formed at the end of each branch of the tree-like conidiophore. When the first conidium is ripe, it is pushed to the side by an unequal swelling of the point to which it is attached. The top of this swollen portion then begins to grow in the original direction of the branch into a new conidial point; and when this has reached a length equal to that of a conidium, or a conidium and a half, a new conidium is produced at its apex. The same process may be repeated in vigorous specimens from 10 to 15 times. After the falling of the very easily shed conidia, as many swellings remain on each branch of the conidiophore as there had been conidia; such swellings do not occur in the stems of the true Peronospora, but are a sure empirical character of the Phytophthora. Among the well-known forms of the family, the potato

fungus, Peronospora infestans, Mont., is the only one which has this peculiarity. It may therefore be distinguished as Phytophthora infestans.

[This article was reprinted verbatim in J. Bot., N. S., 5 (14), p. 105, April 1876]

THE EIGHT GENERA WHICH HAVE BEEN PLACED IN SYNONYMY WITH IT

BLEPHAROSPORA Petri in R. C. Accad. Lincei, Ser. 5, 26, 11, p. 299, 2nd December 1917. Petri's only species is Blepharospora cambivora Petri.

A synonym of Phytophthora fide Buisman in Meded. phytopath. Lab. Scholten 11, pp. 4-7, May 1927; reprinted as Proefschrift Universiteit Utrecht [Thesis, University of Utrecht], Haarlem, 1927.

Combined species and genus description [see under B. cambivora]

B. aurantii Peyronel [see appendix]

B. terrestris (Sherbakoff) Peyronel [see under Phytophthora terrestris]

KAWAKAMIA Miyabe in Bot. Mag. Tokyo, 17, 202, pp. 306-307, 20th December 1903. Miyabe's only species is given as Kawakamia cyperi (Miyabe & Ideta) Miyabe syn. Peronospora (?) cyperi Miyabe & Ideta, Lehrbuch der Pflanzenkrankheiten, Tokyo, p. 122 [published in 1904], but Ideta had already published the name Peronospora cyperi earlier in 1903.

A synonym of Phytophthora fide Fitzpatrick, The Lower Fungi — Phycomycetes, New York, pp. 207-208, 1930.

Mycelium parasitic on living plants, slender, copiously branched, inter-cellular; in older portions, sometimes sparingly septate; haustoria wanting (?). Conidiophores springing either singly or in a bundle of 2 to 5 or more from the slit of a stoma; simple or sometimes branched without any order, generally once and that never from the base of conidium; slender and provided generally at the tip with a short pedicel-cell, which is more slender than the conidiophore. Conidia lemon-shaped, produced at apex into an obtuse prominent beak, with colourless contents and with thin, smooth, and colourless membrane; cross partition between the conidium and pedicel-cell thickens conspicuously, and remains attached to a fallen conidium forming a peculiar short tail; germinate by producing numerous zoospores, or in moist atmosphere by emitting from the tip one or two germ-tubes. Zoospores oval, with two cilia attached at a flattened side. Oogonia and antheridia intercellular, the former spherical and the latter club-shaped. Oospores spherical, one in each oogonium, and with a smooth wall. Germination not yet known.

This genus is nearly allied to Phytophthora, from which it differs by the presence of a pedicel-cell and a peculiar tail-like appendage to its conidium, and also by the shape of the conidia and conidiophores.

[From a translation of the original by Dr. Z. Hidaka.]

K. carica Hara

K. colocasiae (Raciborski) Sawada

K. cyperi (Ideta) Sawada

K. cyperi-iriae (Sawada) Sawada

K. cyperi-rotundati (Sawada) Sawada

K. lepironiae (Sawada) Sawada

K. polygoni (Sawada) Sawada

[See below under Phytophthora.]

MYCELOPHAGUS Mangin in C. R. Acad. Sci., Paris, 136, p. 472, 16th February 1903. Mangin's only species is Mycelophagus castaneae Mangin.

A synonym of Phytophthora fide Clements & Shear, The Genera of Fungi,

New York, p. 241, 1931.

Combined species and genus description, see appendix.

NOZEMIA Pethybridge in *Sci. Proc. R. Dublin Soc.*, N. S., 13, 35, pp. 556-557, March 1913. Type species N. cactorum (Lebert & Cohn) Pethybridge.

A synonym of *Phytophthora* fide Lafferty & Pethybridge in *Sci. Proc. R. Dublin Soc.*, 17, 4, pp. 39-40, 28th June 1922.

For the species belonging to the *Cactorum*-group I propose the new generic name, Nozemia, and characterize the genus as follows:-

Mycelium in cellulas matricis, quas enecat, haustoriis sparsis vel nullis instructum. Hyphae conidiophorae plerumque parum ramosae. Conidia primo acrogena dein etiam pleurogena, ovata, apice papillata, zoosporipara. Antheridia et oogonia in singulis ramis brevibus ex eadem hypha simul orientia. Antheridia oogoniis lateraliter penetrata. Oosporae globosae episporio subtenui, levi, brunneo tectae.

[Mycelium in the cells of the host, which it kills, bearing sparse or no haustoria. Conidiophore hyphae generally not branched. Conidia at first acrogenous then also pleurogenous, ovate, with a papillate apex, producing zoospores. Antheridia and oogonia on single short branches arising from the same hypha at the same time. Antheridia penetrate laterally into the oogonia. Oospores globose with a somewhat thin, smooth, brown-walled episporium.]

N. fagi (Hartig) Pethyb.

N. syringae (Klebahn) Pethyb.

N. nicotianae (van Breda de Haan) Pethyb.

N. lepironiae (Sawada) Sawada

[See below under *Phytophthora*.]

PHLOEOPHTHORA Klebahn in *Zbl. Bakt.*, Abt. 2, 15, 10-11, p. 336, [?May] 1906. Klebahn's only species is Phloeophthora syringae Klebahn.

A synonym of *Phytophthora* fide Klebahn, *Krankheiten des Flieders*, Berlin, pp. 62, 74, 1909.

Combined species and genus description see under P. syringae.

Phloeophthora cactorum (Lebert & Cohn) Wilson

P. fagi (Hartig) Wilson

P. nicotianae (van Breda de Haan) Wilson

[See below under *Phytophthora*.]

PSEUDOPYTHIUM Sideris nomen nudum in *Phytopathology*, 20, 12, p. 953, December 1930. The only species is Pseudopythium phytophthoron Sideris.

Based on a misdetermination of *Phytophthora cinnamomi*. Diagnosis and description withdrawn before publication fide Mehrlich in *Mycologia*, 24, 5, pp. 453-454, September-October 1932.

PYTHIACYSTIS R. E. Smith & E. H. Smith in *Bot. Gaz.*, 42, p. 221, September 1906. The only species is Pythiacystis citrophthora Smith & Smith.

A synonym of *Phytophthora* fide Leonian in *Amer. J. Bot.*, 12, 7, p. 445, July 1925.

Parasitic on living plants, or saprophytic with abundant moisture. Fertile mycelium delicate, septate, with numerous terminal, sympodially developed sporangia. Aquatic mycelium typically sterile, with occasional conidia or sporangia. Filaments very large and vigorous, continuous, much branched.

Sporangia typically rounded or ovate, dividing internally into biciliate swarm-spores which immediately become motile and emerge from a terminal opening. Conidia similar to sporangia, germinating directly by a germ tube. Sexual reproduction not observed.

PYTHIOMORPHA Petersen in Bot. Tidsskr., 29, 4, p. 391, December 1909; English version in Ann. Mycol., 8, 5, p. 528, October 1910. Petersen's only species is Pythiomorpha gonapodyides Petersen [see appendix].

A synonym of Phytophthora fide Buisman, Proefschrift Universiteit Utrecht, Haarlem, pp. 4-7, 1927.

Mycelium ramosum, membrana chlor. zinc iodato rubro-violaceo colorata. Propagatio adhuc cognita zoosporis duobus ciliis lateralibus munitis vesica non cinctis exeuntibus efficitur.

[Mycelium branched, wall coloured red-violet with chlor zinc iodide. Propagation, as far as is known, effected by zoospores furnished with two lateral cilia, coming out not encircled by a vesicle.]

Pythiomorpha fischeriana Höhnk

P. miyabeana Ito & Nagai

P. oryzae Ito & Nagai

P. undulata (Petersen) Apinis

[See appendix].

THE SPECIES (ARRANGED ALPHABETICALLY) WITH ANY EARLIER COMBINATIONS ON WHICH THEY WERE BASED

PHYTOPHTHORA AGAVES Villada apud Gandara in Mem. Soc. 'Ant. Alzate', 25, 9-12, p. 304, 6th January 1909.

Una enfermedad semejante á la anterior ha sido observada en las Haciendas de Ometusco y San Javier del Estado de Hidalgo, primero por el Sr. Dr. D. Manuel M. Villada, y después por el Sr. Prof. D. Alfonso L. Herrera. Ambos señores encontraron como causa del mal, á un hongo del género Phytophthora, que fué especificado por el señor Villada, como Agaves.

Los remitentes de los magueyes así atacados, aseguraron ser 'El Clavillo' el nombre de la enfermedad.

[A disease similar to the foregoing has been observed on the Ometusco and San Javier Estates in the State of Hidalgo [Mexico], first by Dr. D. Manuel M. Villada and later by Professor D. Alfonso L. Herrera. Both found the disease was caused by a fungus of the genus Phytophthora, which was specified by Señor Villada as Agaves.

The senders of the diseased specimens suggest the name 'spike' for the disease.]

PHYTOPHTHORA ALLII Sawada in Nôji Shikenjô Tokubetsu Hôkoku (Spec. Rep. agric. Exper. Sta.) Formosa 11, pp. 59-60, pls. 1-2, February 1915. [Japanese].

Forming a cottony white mycelial mass on diseased portions of leaves and flowers of Allium fistulosum. Hyphae filiform, hyaline, thin-walled, with granular contents, continuous when young but always septate when old, much branched, 3-8 μ across, penetrating the cell walls of the host tissues. Haustoria not observed. Conidiophores appear through stomata of the host or sometimes break through the epidermal tissue, mostly accompanied by hyphae; conidiophores filiform, fine, single or branching pseudodichotomously or rather irregularly ramose, 140-480 $\times$ 4-6 μ ; conidia terminal, globular, ovoid, obovoid or lemon-shaped, hyaline, apically mamillate with a hemispherical papilla 5-10 μ high, 40-74 $\times$ 30-50 μ , averaging 49.4 $\times$ 36.5 μ , with or without a thickened septum at the base; falling off not rarely with a portion of persistent conidiophore at the end, producing 15-60 zoospores or germinating with germ tube.

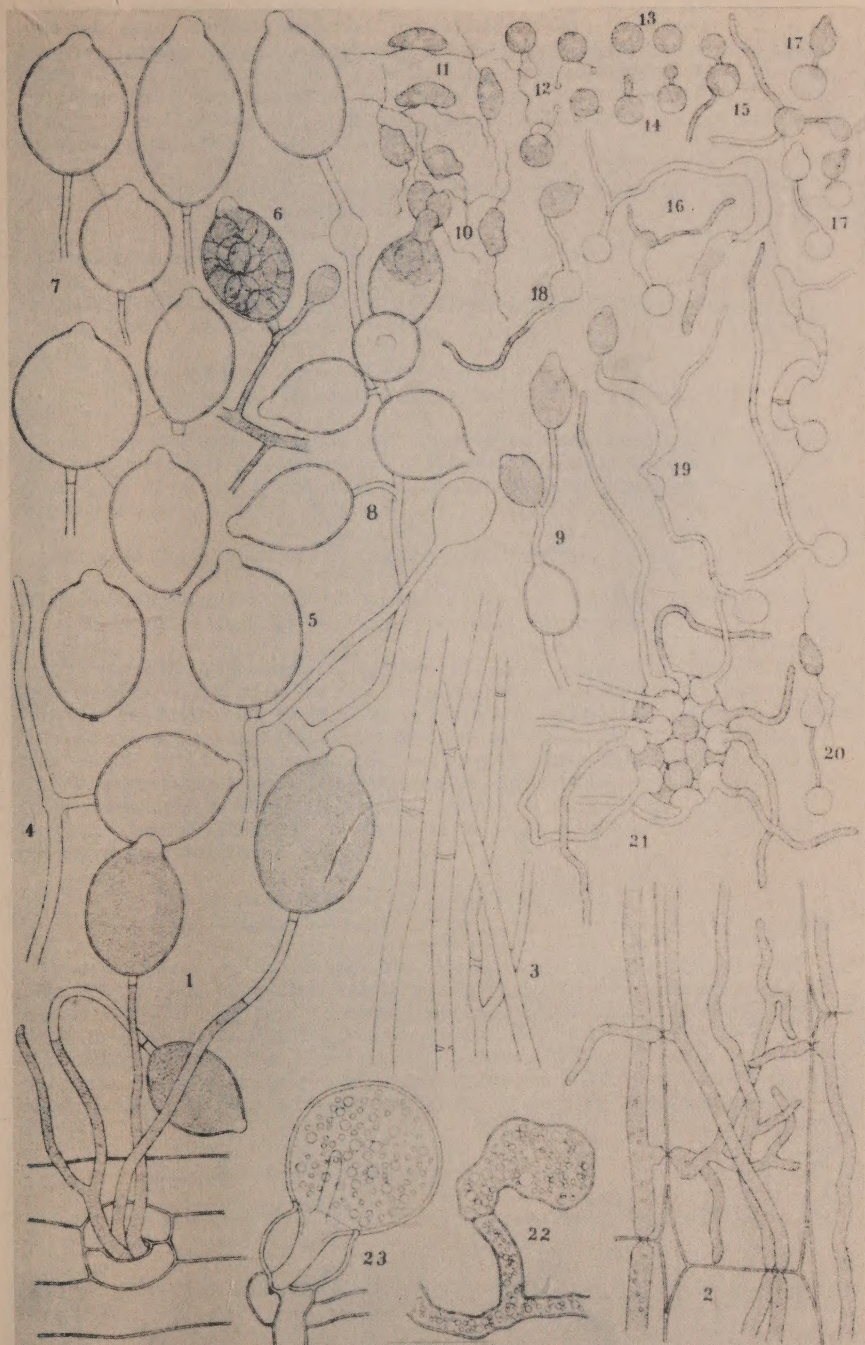


PLATE 1

Phytophthora allii — pl. 1, figs. 1-21, Zeiss 4 × DD; 22, 23, Zeiss 4 × F; pl. 2, figs. 1, 2, Zeiss 4 × F; 3-22, Zeiss 4 × DD. [Slightly reduced from original.]

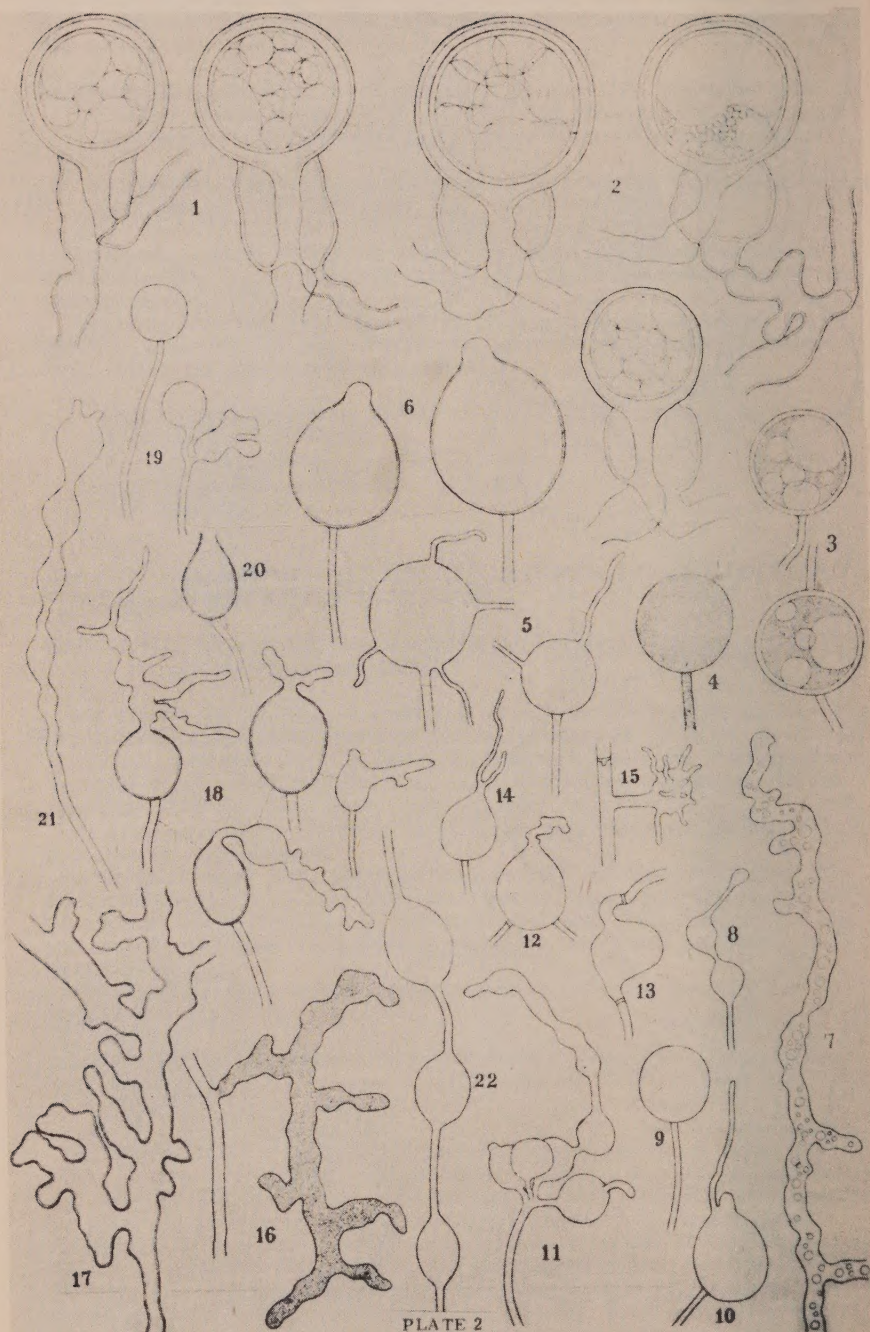


PLATE 2

Phytophthora allii

Oogonial formation was observed in cultures on media made of bean agar and lima bean agar. Oogonia spherical, thin-walled, 17-26 μ (average 20.7 μ) in diameter, containing one oospore; oospores spherical, colourless or pale honey-yellow, 14-23 μ (averaging 16.9 μ) in diameter, walls 0.5-1.5 μ thick. Antheridium tightly surrounding the stalk of the oogonium, then becoming attached close to the wall of oogonium at the lower portion not far from the juncture of the stalk, usually round to obovoid, 8-18 $\times$ 10-14 μ .

Type locality: Taihoku-chô Chônaiho-shô, Formosa, February and July 1913.

[Translation by T. Tanaka in Mycologia, 9, p. 249, 1917.]

PHYTOPHTHORA ARECAE (Coleman) Pethybridge in Sci. Proc. R. Dublin Soc., 13 (N.S.), 35, p. 555, March 1913.

$\equiv$ P. omnivora var. arecae Coleman [q. v.]

$\equiv$ P. cactorum var. arecae (Coleman) Saccardo & Trotter [q. v.]

Should my suspicions as to the real nature of the sexual organs in P. omnivora var. arecae prove on re-examination of his preparations by the author to be well founded, he will probably concur in adopting the name Phytophthora arecae for this species.

[Diagnosis and figures, see P. omnivora var. arecae.]

PHYTOPHTHORA BOEHMERIAE Sawada in Rep. Govt. Res. Inst. Taihoku 27, pp. 10-11, pl. 1 (figs. 15-24), September 1927. [Japanese.]

Maculis foliicolis, rotundatis, brunneo-olivaceis, hyphis inter vel intra cellulas hospitis, 4-8 μ latis, haustriis cylindraceis instructis; conidiophoris non ramosis, gracilissimis, 15-16 μ longis 2-3.5 μ latis; sporangiis ovoideo-globosis, ovoideis vel oblongo-ovoides, apice distincte papillatis, basi brevissime pedicellatis, 27-72 $\times$ 20-46 μ [average in the original paper 49.9 $\times$ 34.48 μ], per zoosporas germinantibus; ogoniis sphaericis, hyalinis vel brunneis, 21-41 μ diam.; antheridiis diclinis, amphigenis, sphaericis vel obovodeis, 12-16 $\times$ 11-15 μ ; oosporis sphaericis, hyalinis, 17-35 μ diam., pleroticis vel apleroticis, per tubum germinantibus.

Hab. in foliis Boehmeriae niveae Hook. & Arn.

Type locality: Formosa

[Spots on leaves, round, olive-brown, hyphae inter- or intra-cellular in the host, 4-8 μ broad, cylindrical haustoria; non-branching conidiophores, very slender, 15-16 μ long, 2-3.5 μ broad; sporangia round- ovoid, ovoid or oblong-ovoid, apex distinctly papillate, the base with a short stalk, 27-72 $\times$ 20-46 μ , germinating by zoospores; round oogonia, hyaline or brown, 21-41 μ in diameter, antheridia diclinous, amphigynous, round or obovoid, 12-16 $\times$ 11-15 μ ; oospores round, hyaline, 17-35 μ in diameter, plerotic or aplerotic, germinating by a tube.

Hab. on leaves of Boehmeria nivea]

[Latin diagnosis given by S. Ito & Y. Tokunaga in Trans. Sapp. nat. Hist. Soc., 14, 1, pp. 15-16, 1935.]

PERONOSPORA CACTORUM Lebert & Cohn in Beitr. Biol. Pfl., 1, p. 56, figs. I-III, I-IV, 1870.

Mycelii tubi graciles nonnunquam torulosi ramosi, ramis angulo recto patentibus, haustoriis destituti, Stipites conidiophori tenues, in modum cincinni unilateraliter pauce-ramosi, sub apicibus ramorum conidiferis non raro vesiculoso-inflati. Conidia in stipitibus pauca hyalina ellipsoidea vel ovata, apice papilla

prominente munita majuscula = 0.048 mm. ($\frac{1}{28} - \frac{1}{15}$ mm.)

Oogonia conglomerata membrana tenui marcescente munita, singula oosporam singulam exacte globosam episporio valido luteo fusco pellucido laevi praeditam foveitia, diametro = 0.024 mm. ($\frac{1}{40}$ mm.).

Habitat in meatibus intercellularibus parenchymatis variorum
Cactorum quorum morbum putredine quadam finitum efficit.
Observ. heime 1868/9 in viridario excellentissimi ducis a
Jacobi Vratislaviae.

[Mycelial tubes slender sometimes branched in tufts, branches standing at right angles, without haustoria. Conidiophore stalks thin, infrequently branched in a unilateral cincinnus, not rarely inflated into a vesicle below the apex of the conidiophore branch. Conidia few, hyaline, ellipsoid or ovate, apical papilla prominent 35.5-66.6 (average 48) μ .]

Oogonia gregarious, spherical, with a thin wall faintly thickened, oospore single exactly globular, epispore stout, dark yellow, transparent, smooth, 24 μ .

Habitat intercellular in the parenchyma of various diseased, rotting Cacti. Observed in the host 1868/9 in the garden of Jacobi, Bratislava.]

PHYTOPHTHORA CACTORUM (Lebert & Cohn) Schroeter in Kryptogamenfl. Schlesien, 3, 1, p. 236, August 1886.

≡ Peronospora cactorum Leb. & Cohn [q. v.]

≡ Phytophthora omnivora de Bary [q. v.]

≡ Nozemia cactorum (Leb. & Cohn) Pethybridge [see above, under Nozemia]

≡ Phloeophthora cactorum (Leb. & Cohn) Wilson [see above, under Phloeophthora]

Conidienträger schlaff, dünn, wenig verzweigt. Zweige vor dem Conidienansatz nicht verdickt. Conidien end- oder seitenständig, eiförmig 50-60 (manchmal bis 90) μ lang, 35 (manchmal bis 40) μ breit, am Scheitel mit einer Papille, im Wasser bis über 50 Schwärmsporen bidend. Oosporen kugelig, meist 24-30 μ Dchm. Mit zweischichtiger, gelbbrauner, glatter, nicht sehr dicker Membran.

[Conidiophores lax, thin, little branched. Branch before the origin of the conidium not thickened. Conidia terminal or lateral, oval, 50-60 (many as much as 90) μ long, 35 (many up to 40) μ broad, with a papilla at the apex, forming more than 50 swarmspores in water. Oospores spherical, mostly 24-30 μ diam. with a two-layered, yellow brown, smooth, not very thick wall.]

PHYTOPHTHORA CACTORUM var. APPLANATA Chester in J. Arnold Arbor., 13, p. 254, pl. 46 (figs. 17-24), pl. 47 (figs. 27-30), April 1932.

A typo differt sporangii papillis applanatis non prominentibus.

This variety differs from the species in the consistent presence of flattened, non-prominent sporangial papillae.

Parasitic on the young growth of various horticultural varieties of Syringa vulgaris causing a soft dark decay.

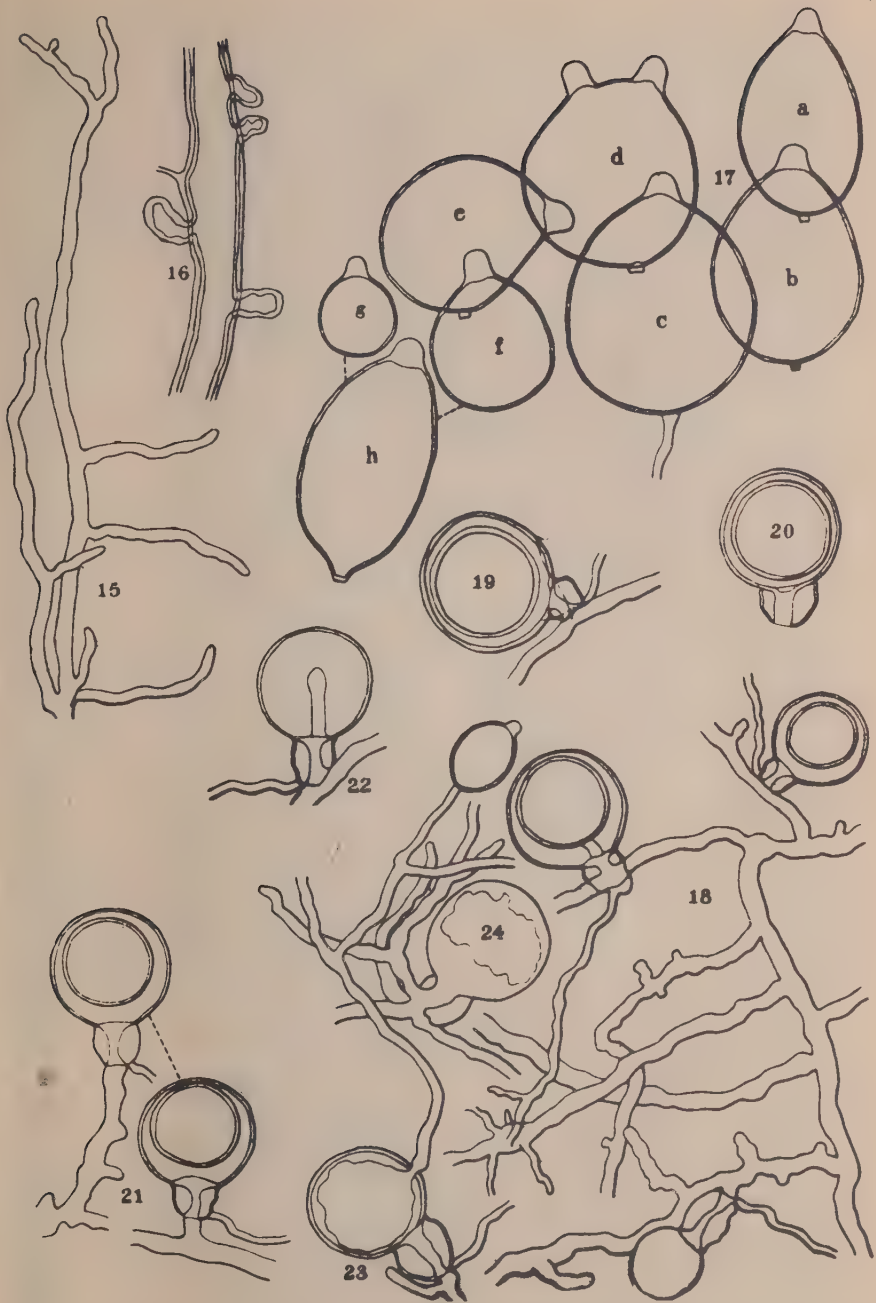
Hab. in Massachusetts, U. S. A.

PHYTOPHTHORA CACTORUM var. ARECAE (Coleman) Saccardo & Trotter in Sylloge fungorum 21, p. 860, 1912.

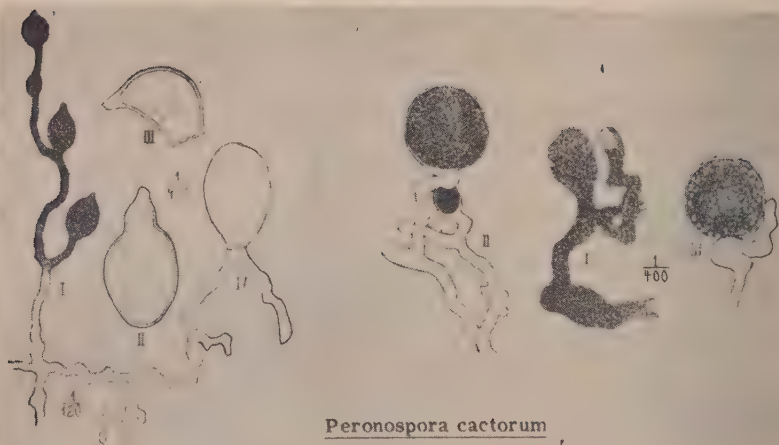
Nov. comb. for P. omnivora var. arecae Coleman

PHYTOPHTHORA CACTORUM subvar. SYRINGAE (Klebahn) Sarejanni in Ann. Inst. phytopath. Benaki, 2, 1, p. 45, 1936 [? 1937].

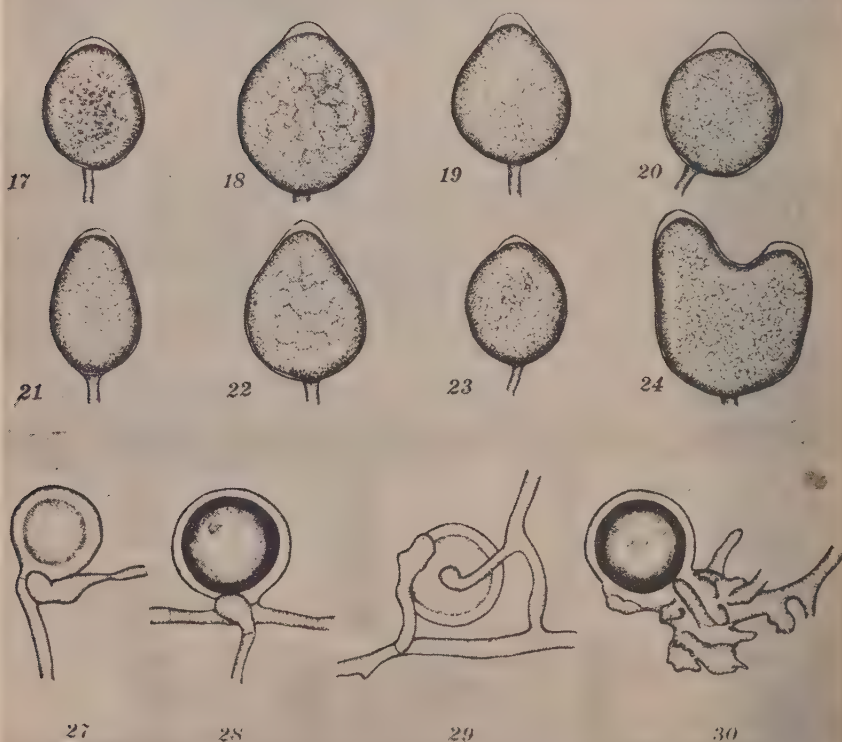
Nomen nudum.



Phytophthora boehmeriae — figs. 15, 17-24, $\times 405$; 16, $\times 940$



Peronospora cactorum



Phytophthora cactorum var. applanata — figs. 17-24, $\times 1,000$; 27-30, $\times 500$

BLEPHAROSPORA CAMBIVORA Petri in R. C. Accad. Lincei, Ser. 5, 26, 11, pp. 297-299, 2nd December 1917.

... al parassita... un micelio pluricellulare, ma che per un tempo più o meno lungo potevasi conservare unicellulare, a percorso intercellulare e intracellulare, formante nel cambio austori globosi e filamentosi.

Sono stati invece ottenuti organi sporogeni trapiantando lembi di strato miceliale, sviluppatosi su carote dopo 1 o 2 mesi di coltura, nella seguente soluzione. ... si formano all'estremità dei filamenti dei corpi sferoidali dapprima, in seguito piriformi, ovali o citriformi, papillati, a contenuto granulosi, che si divide più volte dando origine a spore sferiche munite di un prolungamento coniforme. Queste spore immobili si formano per lo più all'oscuro e a bassa temperatura. Alla luce intensa e a temperatura più elevata, esse sono mobili, munite di duellunghi cigli vibratili. Il loro movimento di traslazione dura per molte ore. Fissandosi perdono i cigli, e germinano come le spore ordinarie. Oltre agli zoosporangi, altri simili di forma, sono fecondati da un ramo anteridiale che è prodotto dallo stesso filamento che porta l'oogonio.

.... il micelio parassita rientra fra le Saprolegninee (Schröter), avvicinandosi alla Pythiaceae e alle Peronosporaceae. Io chiamo questo rappresentante di un nuovo genere col nome di Blepharospora cambivora.

[... the parasite... has a multicellular mycelium, which, however, is capable of remaining for a longer or a shorter time unicellular; its progress is inter- and intracellular and it forms globose or filamentous haustoria in the cambium.

Sporogenous organs were obtained, however, when pieces of mycelium grown on carrot for a month or two were transferred to the following solution. bodies develop at the hyphal extremities, at first spheroidal, later pyriform, ovoid or lemon-shaped, papillate, with granular contents which divide several times giving rise to spherical spores provided with a cone-shaped prolongation. These immobile spores mostly develop in the dark and at low temperatures. In strong light and at a higher temperature they are motile and have two long vibratile cilia. Their motility lasts several hours. Becoming fixed they lose the cilia and germinate like ordinary spores. Besides the sporangia other organs similar in shape are fertilized by an antheridial branch produced by the same hypha that bears the oogonium.

.... the mycelium of the parasite comes into the Saprolegninee (Schröter) near the Pythiaceae and the Peronosporaceae. I consider this a representative of a new genus and name it Blepharospora cambivora.]

Supplementary description by Petri in Ann. Ist. sup. (agr.) for. naz., 3, p. 13, text figs. 3, 4, pl. IV (figs. 4-16), May 1918,

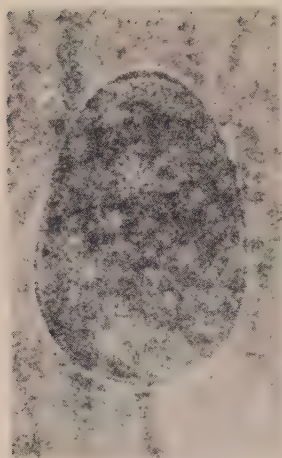
..... caratterizzata dalla formazione di zoosporangi limoniformi, terminali su rami semplici, misuranti $40-54 \times 60-75 \mu$. Micelio abbondante nelle colture e settato, nel tessuto dell'ospite quasi sempre unicellulare, formante austori globosi o filamentosi. Zoospore ovoidali di $12-15 \mu$, con un'estremità assottigliata munite di due ciglia vibratili. Oospore sferoidali, alla maturità leggermente colorite in fuligineo, $20-27 \mu$, di diametro, anteridi originati da ife diverse da quelle oogonifere.

[..... characterized by the formation of limoniform sporangia, terminal on simple branches, measuring $40-54 \times 60-75 \mu$. Mycelium abundant in culture and septate, and in the tissues of the host almost always unicellular, forming globose or filamentous haustoria. Zoospores ovoidal, $12-15 \mu$, with an attenuated extremity furnished with two vibratile cilia. Oospores spheroidal, at maturity faintly sooty coloured, $20-27 \mu$ in diameter, antheridia originating from a hypha different from the one bearing the oogonium.

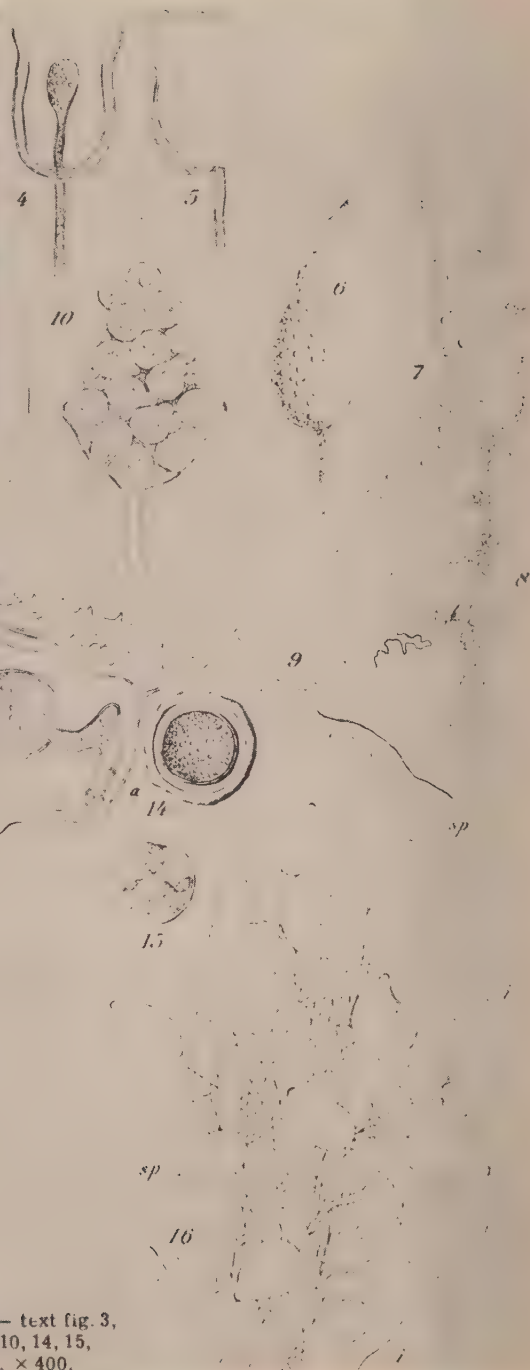
PHYTOPHTHORA CAMBIVORA (Petri) Buisman in Meded. phytopath. Lab.

Scholten 11, pp. 4, 7, May 1927; reprinted as Proefschrift Universiteit Utrecht [Thesis, University of Utrecht], Haarlem, 1927.

≡ Blepharospora cambivora Petri [q. v.]



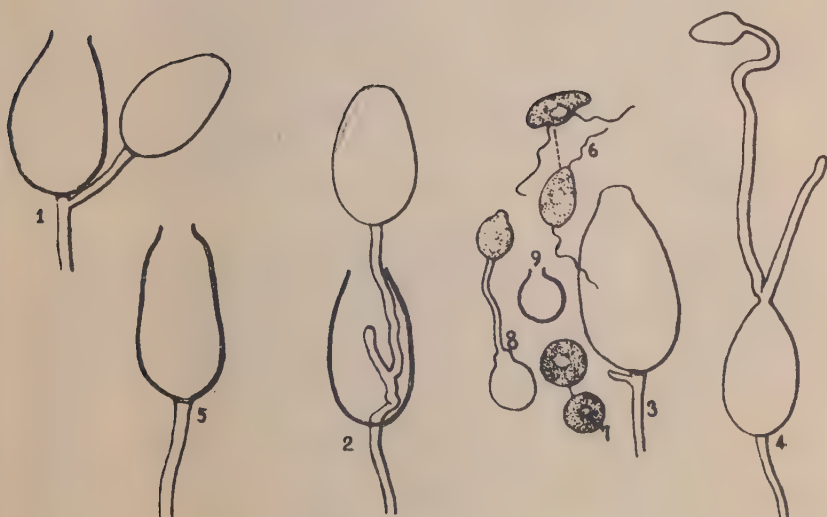
TEXT FIG. 3



Blepharospora cambivora — text fig. 3,
 × 850; figs. 4-9, 13, × 500; 10, 14, 15,
 × 450; 11, 12, × 750; fig. 16, × 400.



Phytophthora canavaliae — no magnification given



Phytophthora cinchonae — figs. 1-9, $\times 405$

PHYTOPHTHORA CANAVALIAE Hara, *Pathologia Agricultura Plantarum*, pp. 848-850, figs. 1-10, 1930. [Japanese.]

Any parts of aerial organs, especially the stems and fruits near the ground, are attacked. On the pods there appear small dark brown, depressed patches, which become larger and later produce white powdery mass. On leaves the lesions are first pale green, later dark brown, round or irregular in shape, but white powdery masses are usually unrecognizable.

Mycelium intercellular, 3-8-8 μ ; conidiophores single or in clusters, usually 5-35 $\times$ 2-2-4-4 μ , simple or in sympodial branching; conidia lemon-shaped, globular, ellipsoidal, or variable in shape, 39-88 $\times$ 20-32 μ , mostly 55 $\times$ 25 μ , papillate, germination by zoospores or occasionally by means of a germ-tube; zoospores ellipsoidal, 2-ciliate, 10-12 $\times$ 7-9 μ ; chlamydospores globular, episporos slightly yellowish, 30-35 μ ; oospores unknown.

On Canavalia ensiformis DC. in Honshu, Japan.

[Translation from the original by Prof. T. Matsumoto.]

PHYTOPHTHORA CAPSICI Leonian in *Phytopathology*, 13, p. 403, fig. 2, September 1922.

$\equiv$ P. parasitica var. capsici (Leonian) Sarejanni [q. v.]

Sporangiophores branched; sporangia generally ovoid, varying in culture to elongated ellipsoid, subsphaeroid, irregularly elongate with intermediate forms; papilla very prominent, either single and apical or sometimes up to three and variously disposed; germination normally by zoospores, under special conditions by germ tubes; size of sporangia extremely variable, 35-85 μ or even 105 $\times$ 21-56 μ , averaging 60 $\times$ 36 μ ; oospores formed on submerged mycelium, abundant on oatmeal and cornmeal agars, slightly wrinkled, brown, semi-transparent, 25-35 μ ; antheridia basal; mycelium often gnarled, becoming densely tuberous under certain cultural conditions; the tuberous outgrowths spherical or ovoid, minute, 5-8 μ , of the same shape as sporangia, richer in protoplasm and darker in colour than the mycelium, often very numerous, giving rise to large grape-like clusters, germinating by germ tubes; no chlamydospores observed.

Parasitic on stems and fruit of Capsicum annum, State College, New Mexico.

KAWAKAMIA CARICA Hara in *Nôgyôkoku* (Agriculturalist), 9, 3, pp. 24-27, May 1915. [Japanese.]

Hyphae colourless, sometimes with a few septa, 2-3 μ in width. Sporangia apical and of various shapes, oval, elongated ellipsoid, or nearly spherical, with a thin, smooth, colourless wall, 40-68 (-87:5) $\mu \times$ (15-18-25 μ . Pedicels of the sporangia 10-20 $\times$ 2-2.5 μ . Zoospores 8-16 in number, ovoid or ellipsoid, 10-12 μ in diameter at rest. Oogonium [?chlamydospore] spherical or nearly so, 20-30 μ in diameter, colourless at first, wall later yellowish, smooth, and thick (2-3 μ), containing a large oil vacuole.

On White Genoa fig fruits causing a white rot; at Komaba, Tokyo, Japan, September, 1909.

[From a translation of the original by Dr. Z. Hidaka.]

PHYTOPHTHORA CARICA (Hara) Hori in *J. Pl. Prot.*, Tokyo, 2, 12, p. 1017, December 1915. [Japanese.]

$\equiv$ P. carica (Hara) Hara, *A Discourse on Fruit Diseases*, p. 432, November 1916 fide Tanaka in *Mycologia*, 12, 1, p. 25, January 1920.

..... there is no question that the pathogenic fungus does not belong to the

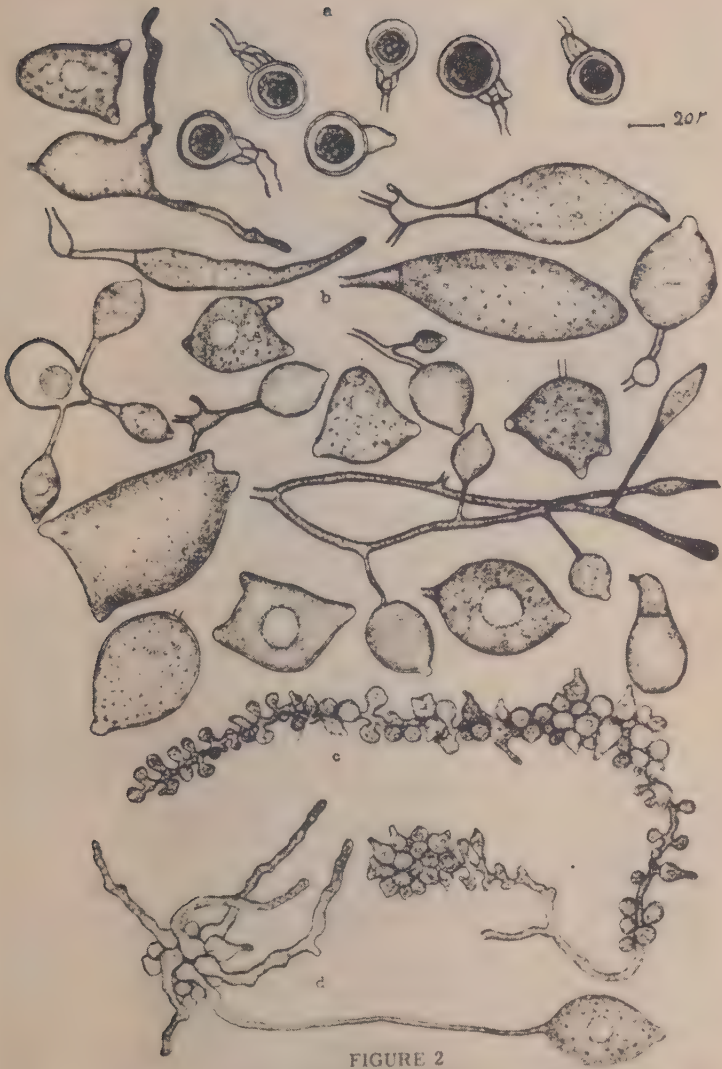


FIGURE 2
Phytophthora capsici

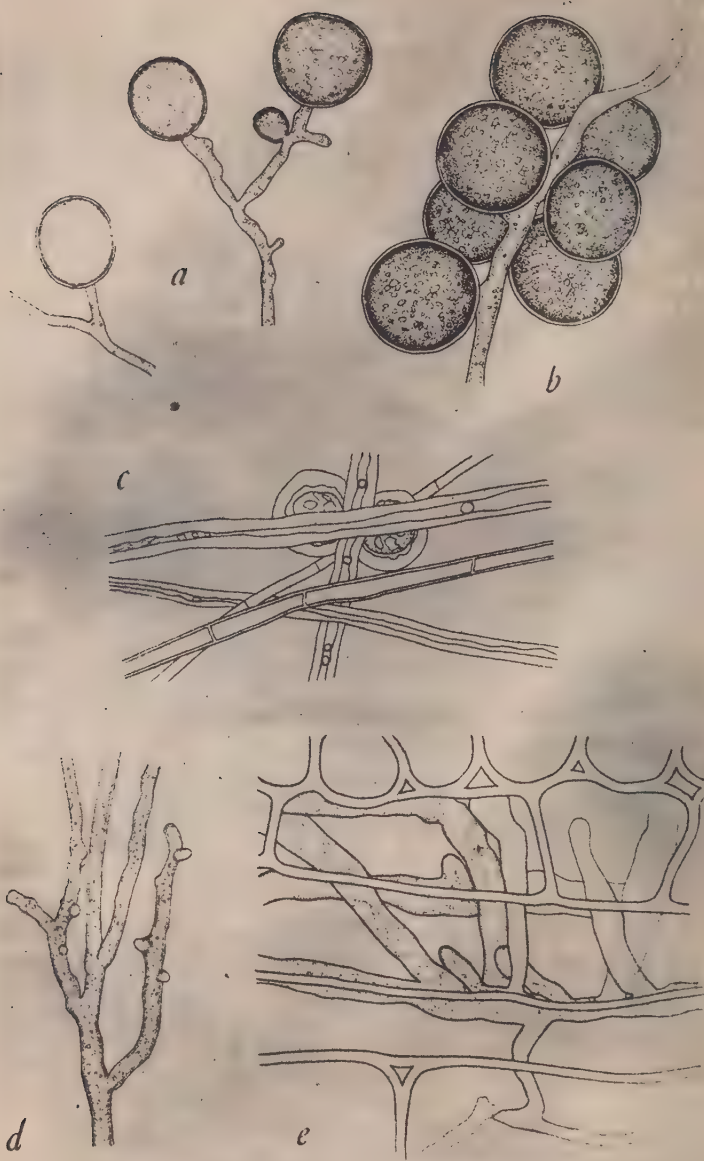


PLATE 5

Phytophthora cinnamomi — pl. 5, figs. a-d, $\times 500$; e, no magnification given;
 pl. 6, figs. a, b, k, $\times 345-6$; c, $\times 765$; d-f, m, n, $\times 555$; g, h, $\times 236$; i, j, l, $\times 356$

genus *Kawakamia*, but to the genus *Phytophthora*. Therefore the scientific name should be changed from that of Mr. Hara to *Phytophthora carica* (Hara) Hori.

[From a translation of the original by Dr. Z. Hidaka.]

[In November 1915 Hori had already described what appears to be the same disease under the name *Phytophthora fici*, q. v.]

PHYTOPHTHORA CINCHONAE Sawada in *Agric. Mag. Formosa*, 32, 5, p. 1, 1936.

Intracellular, hyaline, aseptate mycelium 3-6 μ in diameter in the host. In culture the mycelium is much branched, at first aseptate, with pseudosepta when old, thin-walled, hyaline, 5-15 μ in diameter; irregular tuber-like vesicles on the mycelium, thin-walled, smooth, hyaline, with dense contents, 24-53 μ , resembling the young stage of chlamydospores.

Conidia not formed on media, but by aerial mycelium placed in water. Conidiophore 4 μ in diameter, the subsequent conidia being formed on branches arising just below the first or by proliferation through the empty sporangium. Conidia hyaline, smooth, ovoid, rounded at the base, papillate at the apex, empty at the papilla, 18-68 $\times$ 13-38 μ , averaging (43) 41.12 $\times$ 23.02 μ and with an l/d ratio of 1.79, infrequently attached by the side. Zoospores formed without a vesicle, 15-17 $\times$ 12-13 μ with two ventral cilia; resting zoospores globose, 12-16 μ diam., germinating by tubes 2 μ in diameter, which may form a terminal secondary sporangium (13 $\times$ 10 μ), or giving rise to zoospores again (diplanetism). Conidia giving direct germination produce germ tubes through the papilla often ending in a secondary conidium. Oospores not formed.

On one year old seedlings of *Cinchona succirubra* and *C. ledgeriana* at Rai village, Kaohsiung, 19. v. 1923.

[From a translation of the original by Dr. C. T. Wei. Figures in *Rep. Govt. Res. Inst., Taiwan* (formerly *Formosa*), 83, pl. I, figs. 1-9, 1942.]

PHYTOPHTHORA CINNAMOMI Rands in *Meded. Inst. PlZiekt.*, Buitenz., 54, p. 41, pls. 5, 6, 1922.

Maculis in cortice *Cinnamomi burmanni* perpendicularibus, elongatis, linearibus vel irregularibus, 1-5 cm. latis, saepe supra terram usque ad 10 M. in altitudinem extensis insita; cortice mortuo radiatim zonato. Mycelio in cortice et ligno exteriore, irregulari; hyphis aeriis in agare avenae cultis tenuibus, 5-7 μ crassis, primo continuis, deinde septatis; haustoria absunt. Chlamydosporis et inter et intra cellulas matricis formatis, tenuibus, globosis vel pyriformibus; plerumque 31-50 μ in diam., in apice ramorum brevium nascentibus, copiosis in culturis artificialibus, saepe 3-10 in racemis coalitis; hyphis 3-11 germinantibus. Conidiophoris non a mycelio distinctis simplicibus vel sympodio-ramosis. Conidiis neque in natura neque in culturis artificialibus visis, sed copiose nascentibus in mycelio e solutione nutritia in aquam translato, primo terminalibus, plerumque ovoideis vel ellipsoideis, hyalinis, tenuibus; plerumque 38-84 $\times$ 27-39 μ , fere 57 $\times$ 33 μ latis, papillis latis, brevibus; conidiis ulterioribus sympodilater e ramis conidiophori nascentibus, saepe hypha fertile proliferata e conidiis vacuis egredientibus; parietibus conidorum expulsionem finitam partim collapsis; conidiis in aqua fere zoosporis, sed nonnumquam tubo vel conidiis secundariis germinantibus; conidiis e culturis infirmis vel contaminatis saepe abnormaliter germinantibus; zoosporis 8-40, plerumque concavoconvexis, ciliis duabus inaequalibus longitudine, lateraliter insertis, mobilibus, motis circa 11 $\times$ 18 μ , quietis 10-11 μ in diametrum, tubo germinantibus. Oosporis non visis.

Hab. in cortice viva *Cinnamomi burmanni* Bl. in insula Sumatra Indiae.

Mycelium permeating bark and outermost layers of wood; irregular, sparingly branched, inter- and intracellular, bearing occasionally chlamydospores in the

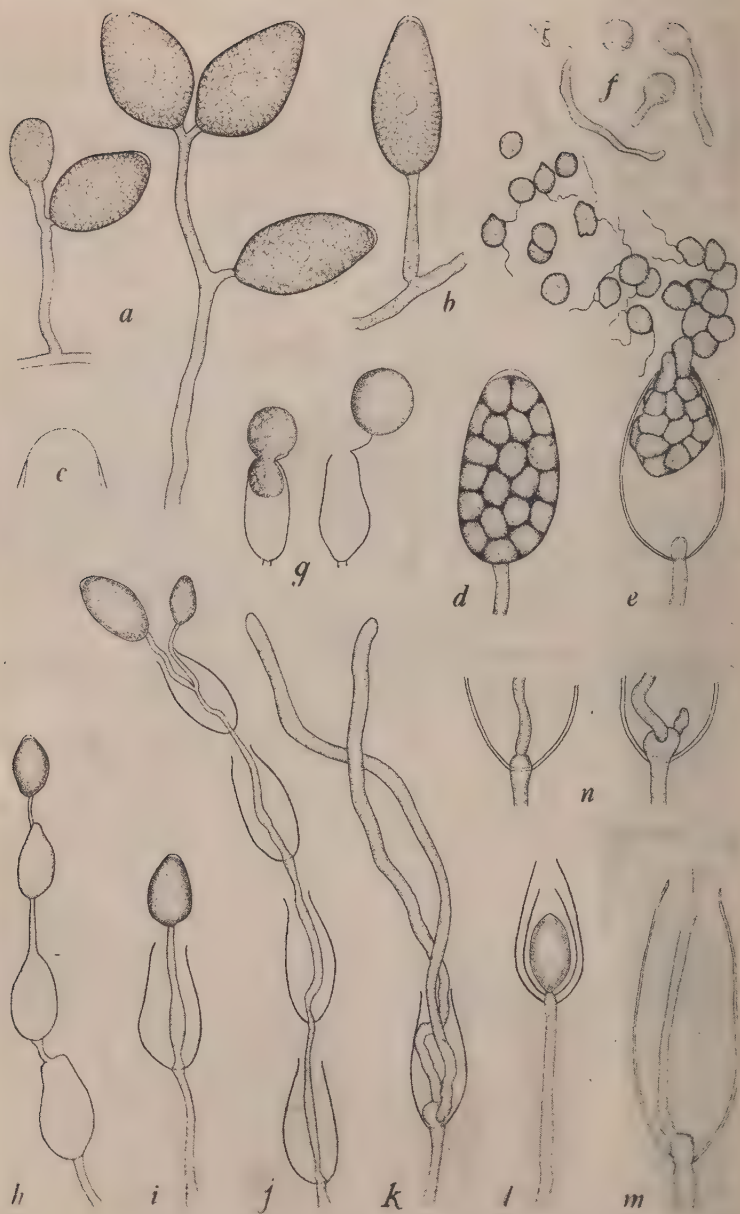


PLATE 6

Phytophthora cinnamomi

tissues; aerial hyphae on oat agar hyaline, slender, 5-7 μ in diam., with age becoming thick walled and septate, haustoria not observed. Chlamydo-spores thin walled, globose to pyriform mostly 31-50 μ in diam., average 41 μ , terminal or on short lateral branches; abundant in artificial cultures, frequently occurring in grapelike bunches or clusters of 3-10 spores; germinating by 3-11 germ tubes. Conidiophores undifferentiated, simple, or sympodially branched. Conidia not observed in nature nor in ordinary artificial cultures, but abundantly produced on mycelium transferred from nutrient solution to water; borne terminally and varying in shape from ovoid to ellipsoid or elongate, hyaline, thin walled, with broad, flat, inconspicuous papilla on end opposite point of attachment; size mostly 38-84 $\times$ 27-39 μ , average 57 $\times$ 33 μ ; secondary conidia produced on branches of conidiophore in successive sympodial fashion, but frequently also by successive proliferation through the empty ones; spore case partially collapsing after discharge, germinating in water generally by liberation of zoospores but occasionally by a tube developing hyphae or secondary conidia, conidial discharge in weak or contaminated cultures often abnormal, the zoospores failing to separate and the extruded mass disintegrating. Zoospores 8-40 from one conidium, more or less bean or kidney shaped with two flagella of unequal length attached to concave side; while swimming about 11 $\times$ 18 μ , and after coming to rest 10-11 μ in diam.; germinating after about an hour by a tube. Oospores not observed.

Causing stripe canker of the bark of *Cinnamomum burmanni* Bl.
(*Malay kulit manis*) in West Coast Highlands of Sumatra:]

PHYTOPHTHORA CITRI Venkata Rau in *J. Bombay nat. Hist. Soc.*, 24, 3, p. 615, 20th June 1916.

I have come across a disease on citron (*Citrus medica*) Vern. Can. Madala-Hannu in the Bababudans... apparently new to science. I propose provisionally the name *Phytophthora citri*. It is interesting to note that oospores are found sunken in the outer tissues of the citron fruit. A comparative study is being made in this Department when the question of nomenclature will definitely be settled.

PHYTOPHTHORA CITRICOLA Sawada in *Rep. Govt. Res. Inst.*, Formosa, 27, pp. 22-24, pl. II (figs. 10-19), September 1927. [Japanese.]

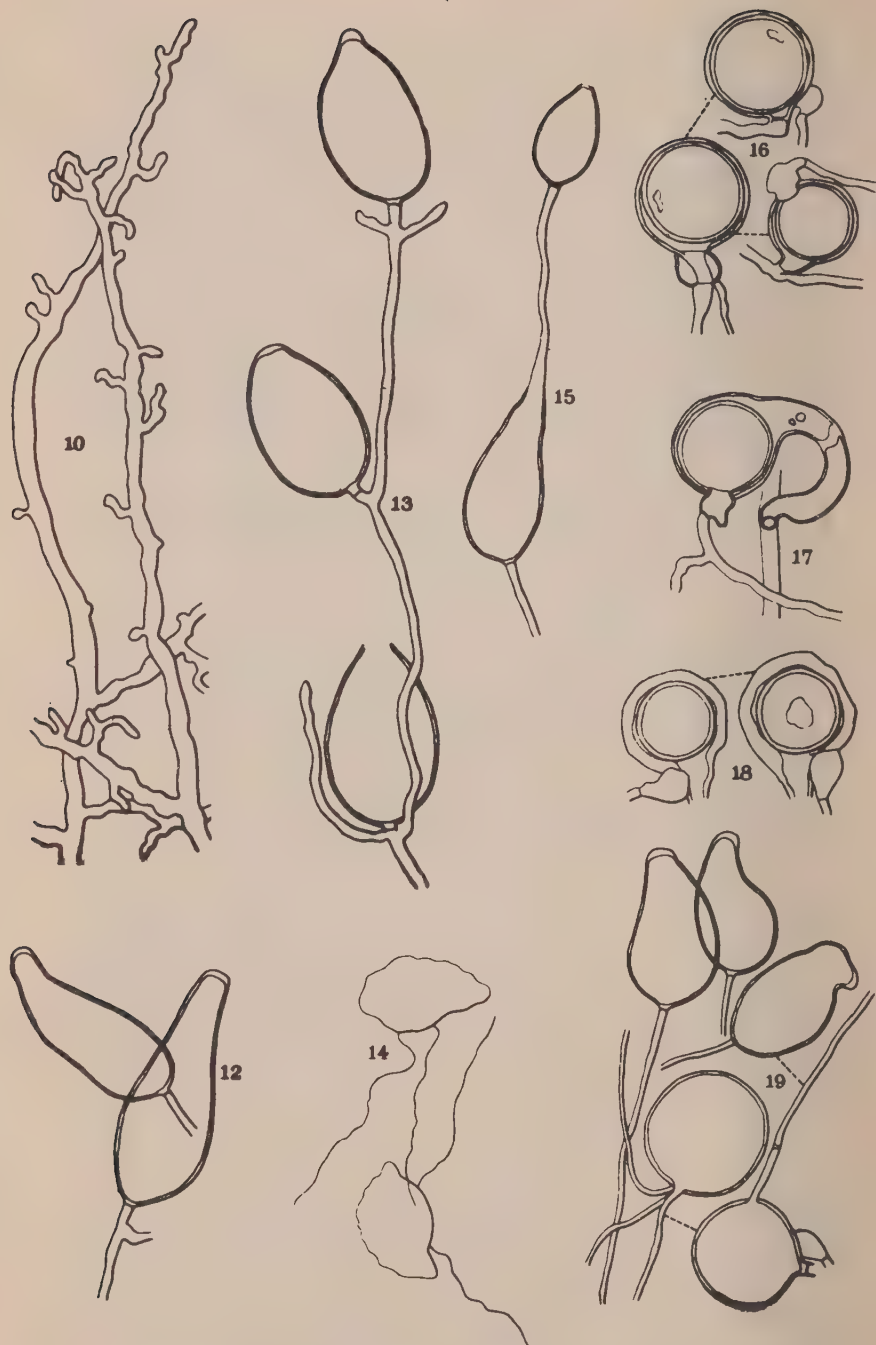
Maculis fructicolis, primo rotundatis dein totam superficiem fructuum occupantibus, brunneis; hyphis 4-10 μ latis, haustrio carentibus; conidiophoris simplicibus vel sympodice ramosis; sporangiis ovoideis vel obclavatis, basi rotundatis, papilla plana lataque ornatis, 21-70 $\times$ 15-39 μ [average in the original paper 43.3 $\times$ 25.3 μ], per zoosporas vel raro per tubum germinantibus; zoosporis ovoideis, attenuatis biciliatis, 13 $\times$ 8-9 μ ; oogoniis sphaericis, interdum basi corniformiter attenuatis, hyalinis vel brunneis, 21-44 μ diam., membrana levi, 1-1.5 μ vel raro 4 μ crasso; antheridiis obovoideis, paragenis vel rarissime amphigenis, 12-13 $\times$ 8-10 μ ; oosporis sphaericis, paene pleroticis, hyalinis vel luteis, 18-38 μ diam., episporio levi, 1-2 μ crasso tectis.

Hab. in fructis *Citri sinensis* Osb. f. *Sekkan* Hayata necnon *C. Tankan* Hay. form., etc. in Formosa.

[Spots on the fruit, round at first then spreading over the whole surface of the fruit, brown, hyphae 4-10 μ wide, no haustoria; conidiophores simply or sympodially branched; sporangia ovoid or obclavate, round base, papilla flat and broad, 21-70 $\times$ 15-39 μ , germinating by zoospores or sometimes tube; ovoid zoospores, laterally biciliate, 13 $\times$ 8-9 μ ; round oogonia, base occasionally hornshaped, hyaline or brown, 21-44 μ in diameter, smooth membranes, 1-1.5 μ or rarely 4 μ thick; obovoid antheridia, paragynous or rarely amphigynous, 12-13 $\times$ 8-10 μ ; oospores round almost plerotic, hyaline or yellow, 18-38 μ in diameter, smooth episporis, 1-2 μ thick wall.]

Hab. on the fruit of *Citri sinensis*.]

[Latin diagnosis given by S. Ito & Y. Tokunaga in *Trans. Sapp. nat. Hist. Soc.*, 14, 1, p. 14, 1935.]



Phytophthora citricola — figs. 10, 12, 13, 15-19, $\times 405$; 14, $\times 940$

PYTHIACYSTIS CITROPHTHORA R. E. Smith & E. H. Smith in Bot. Gaz., 42, p. 221, figs. 2-3, September 1906.

Parasitic on lemons, and occasionally other Citrus fruit causing decay of green fruit on the tree and in the storehouse. Mycelium in affected fruit sterile, inhabiting rind and fibrous portions. Internal, except in moist air. Mycelium in water or nutrient liquids very vigorous, usually sterile, or occasionally with conidia or sporangia. Fruiting stage found typically in moist soil, in contact with affected fruit. Sporangia ovate or lemon-shaped, sometimes rounded, considerably elongated, or double, with terminal protuberance; $20 \times 30 \mu$ to $60 \times 90 \mu$, av. $35 \times 50 \mu$. Produced in great abundance under favourable conditions. In water dividing quickly by internal division into 5 to 40 (usually about 30) swarmspores, which are immediately set free and discharged through a terminal pore.

Swarmspores $10-16 \mu$ in diameter, at first elongated, becoming rounded; with two lateral cilia 30 to 40μ in length. Actively motile when discharged, soon coming to rest and germinating.

Abundant in winter and spring in southern California lemon orchards and packing houses, causing serious losses.

PHYTOPHTHORA CITROPHTHORA (Smith & Smith) Leonian in Amer. J. Bot., 12, 7, p. 445, July 1925.

≡ Pythiacystis citrophthora R. E. Smith & E. H. Smith [q. v.]

This organism is so obviously a Phytophthora species that the genus Pythiacystis is no longer tenable.

PHYTOPHTHORA COLOCASIAE Raciborski, Parasitische Algen und Pilze, Java's. I, Batavia, p. 9, 1900.

≡ Kawakamia colocasiae (Racib.) Sawada in Spec. Rep. agric. Exp. Sta.

Formosa 2, p. 76, 16th November 1911 fide Butler in Mem. Dept. Agric.

India Bot., 5, 5, pp. 233-234, 256, May 1913.

≡ P. parasitica var. colocasiae (Racib.) Sarejanni [q. v.]

Die unseptierten $3-4 \mu$ dicken Hyphen... Die Sporangien tragenden Hyphen ragen nur äusserst wenig über die Spaltöffnungen, aus welchen sie heraustreten hervor, schwellen an der Spitze bedeutend an und grenzen da, durch eine Querwand ein Sporangium ab, welches gewöhnlich länglich eiförmig, manchmal ein wenig eingeschnürt, beiderseits abgerundet, sehr regelmässig und ziemlich dickwandig erscheint. An der Spitze ist die Sporangiummembran sehr stark verdickt, indem an die eigentliche Wand immer noch ein quellbarer Pfropf eingelagert wird. Bei der Reife fallen die Sporangien, zusammen mit kurzen Stielchen ab; in Wasser gelegt bilden in dem Inneren eine grössere Anzahl Schwärmosporen, welche, indem der erwähnte Pfropf an der Spitze gelöst wird, nach aussen treten, nierenförmig werden und 2 Cilien besitzen. In Wasser kommen sie bald zur Ruhe und keimen, ein secundäres, kleines Sporangium bildend, welches an der Spitzedurchwachsen kann, oder gleich 1-2 neue Schwärmosporen bildet. Oosporen nicht beobachtet. Die Sporangien (ohne Stielchen) $48-55 \mu$ lang, $19-22 \mu$ breit, die Stielchen $3-7 \mu$ lang, die Schwärmosporen $15-18 \mu$ lang, $9-12 \mu$ breit.

Hab. on leaves of Colocasia esculenta

[The non-septate hyphae $3-4 \mu$ thick. . . The sporangia-bearing hyphae are prominent only when they appear slightly above the substratum from which they emerge, significantly swollen at the apex and delimited by a cross wall to form a sporangium, which appears usually elongated, ovoid, more or less compressed, rounded on both sides, very irregular, and fairly thick walled. At the apex the sporangial wall is very strongly thickened, in this special part of the wall a swollen plug always develops. At maturity the sporangia fall off, together

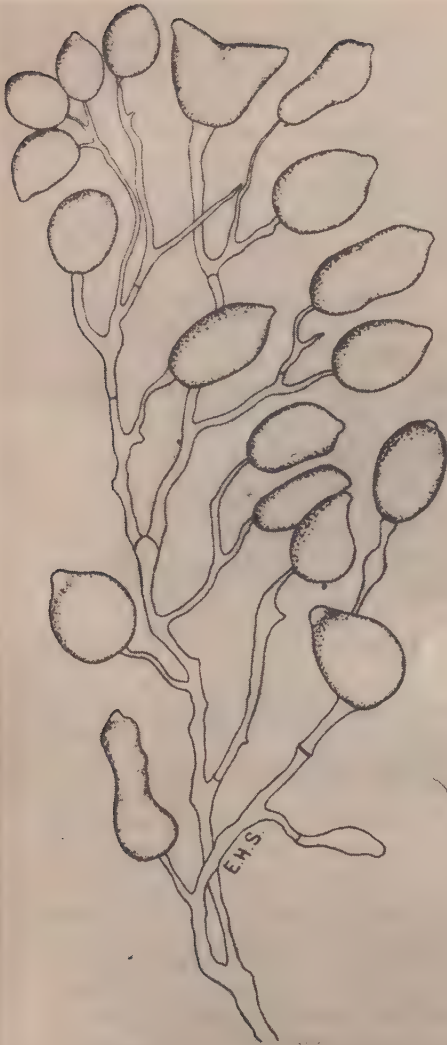


FIGURE 2



FIGURE 3

Pythiacystis citrophthora — no magnification given

with a short pedicel; placed in water a very large number of swarm spores form inside, which, when the above-mentioned apical plug is dissolved, become kidney-shaped and possess two cilia. In water they soon come to rest and germinate, forming a small secondary sporangium, which can continue growth at the apex, or form one or two new swarmspores. Oospores not observed. The sporangia (without the pedicel) are 48-55 μ long, 19-22 μ wide, the pedicel 3-7 μ long, the swarmspores 15-18 μ long, 9-12 μ wide.]

PHYTOPHTHORA CRYPTOGEA Pethybridge & Lafferty in Sci. Proc. R. Dublin Soc., 15 (N.S.), 35, p. 498, pl. 45 (figs. 3-5), pl. 47 (figs. 1-11), February 1919.

Mycelio ramoso quoad partes recentiores e septato vetustiores septato; conidiis plerumque inversipyriformibus 24-50 $\mu \times$ 17-30 μ apicibus obtusis non-papillatis sympodialiter genitis; zoosporis 2-ciliatis 10-15 μ diam. oogoniis hyalinis flavescentibus pyriformibus 30 μ diam.; antheridiis amphigynis hyalinis; oosporis sphaericis flavescentibus crasso episporio praeditis 25 μ diam.

Hab. in radicis caulibusque vivis Lycopersici esculenti et Petuniae sp. in Hibernia.

[Mycelium branched in the new growth and aseptate, septate when old; conidia mostly obpyriform 24-50 $\mu \times$ 17-30 μ , apex obtuse, non-papillate, formed sympodially; zoospores biciliate 10-15 μ in diameter; oogonia golden, hyaline, pyriform, 30 μ in diameter; antheridia hyaline amphigynous; containing round, golden oospores, with a thick episporium, 25 μ in diameter.]

Hab. on living roots and stems of Lycopersicon esculentum and Petunia sp. in Ireland.]

PHYTOPHTHORA CRYPTOGEA var. RICHARDIAE Ashby in Trans. Brit. mycol. Soc., 14, 3-4, p. 259, October 1929.

The author's studies..... have led him to the conclusion that the essential similarities, apart from mere differences in the size of the conidia (sporangia) and sexual organs of P. cryptogea and P. richardiae, do not justify a distinction of species, but that the differences are sufficiently recognised by recording it as a variety, namely P. cryptogea Pethyb. and Lafferty var. richardiae (Buis.).

PERONOSPORA CYPERI Ideta (as P. cyper) in Sinnôhô [New agric. News], 57, pp. 31-32, 1903. [Japanese.]

Cloudy brown spots 2 or 3 inches long on the middle, top, or root part of the stem, at first yellow, then yellowish brown, finally glossy amber. In the stem tissue there is colourless or pale yellow mycelium and yellowish brown oospores, developed by the conjugation of oogonia and antheridia. Conidia not observed.

The nature of the spores makes it clear that the pathogen is a fungus belonging to the Peronosporaeae.

Causing Akayamibyo (red disease) or bekko (tortoise-shell) on Shichito matgrass (Cyperus malaccensis Lam.) in the Ooita Prefecture, Japan.

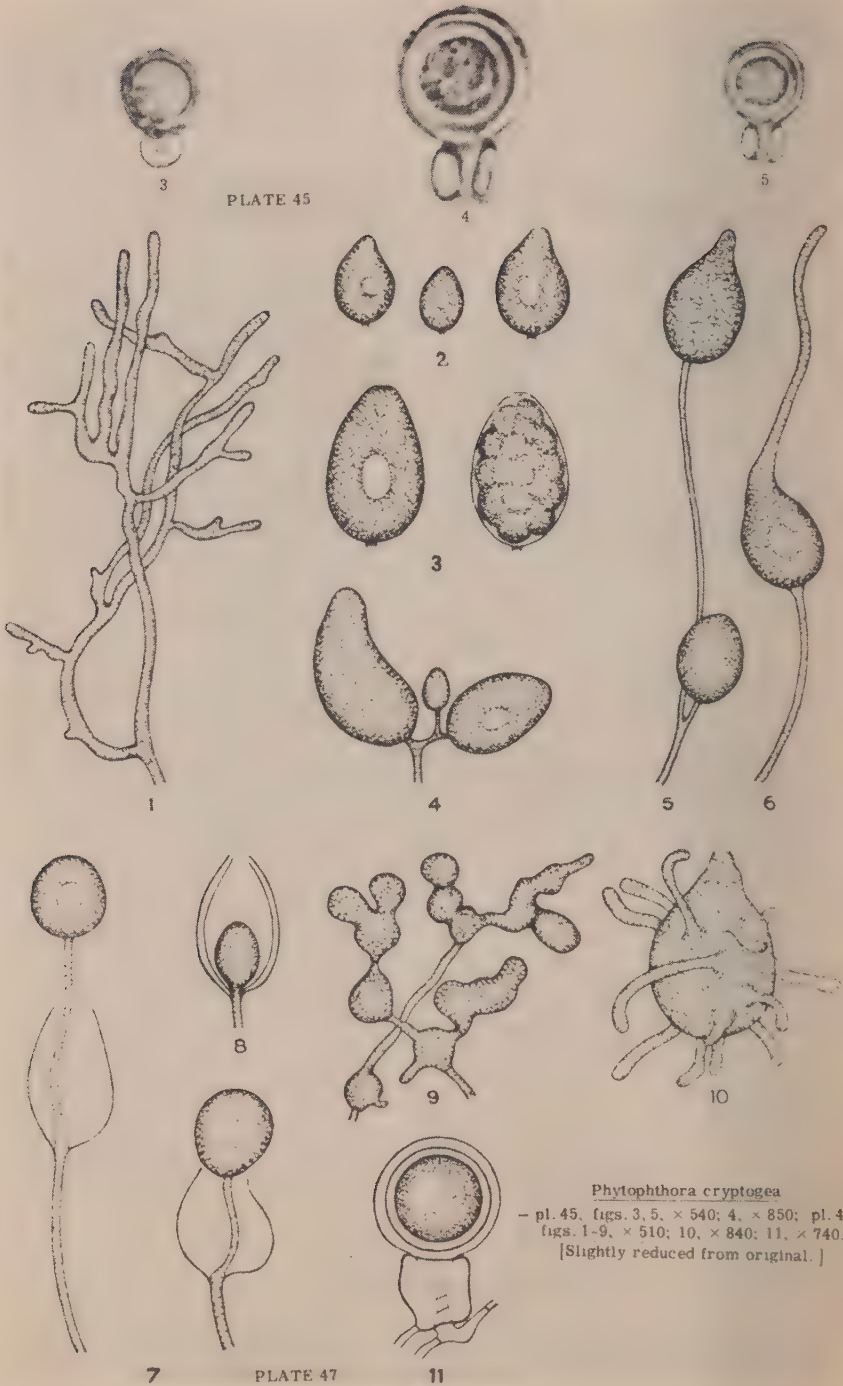
[From a translation of the original by Dr. Z. Hidaka.]

PHYTOPHTHORA CYPERI (Ideta) Ito in Trans. Sapp. nat. Hist. Soc., 14, 1, p. 13, 1935.

≡ Peronospora cyperi Ideta [q. v.]

≡ Kawakamia cyperi (Ideta) Sawada in Agric. Mag. Formosa, 38, 5, p. 351, 1942.

Kawakamia cyperi (Miyabe & Ideta) is based on the later name Peronospora



Phytophthora cryptogea

- pl. 45, figs. 3, 5, $\times 540$; 4, $\times 850$; pl. 47, figs. 1-9, $\times 510$; 10, $\times 840$; 11, $\times 740$.
[Slightly reduced from original.]

(?) *cyperi* Miyabe & Ideta on *Cyperus tegetiformis* Roxb. [see above, under *Kawakamia*].

PHYTOPHTHORA CYPERI-BULBOSI Seethalakshmi & Ramakrishnan in *Curr. Sci.*, 22, pp. 149-150, figs. 1-4, May 1953.

Maculae irregulares, indefinitae, brunneae, amphigenae; hyphae intercellulares, ramosae; sporangiophori emergentes per stomata, haud ramosi, vel sympodiae ramosi, tenues; sporangia obpyriformia, papilla lata, $40 \times 25 \mu$ ($23-50 \times 20-34$), germinantia per productionem zoosporarum vel tuborum germinationis; oogonia efformantia in cavitatibus aeries in vagina foliorum, sphaerica, reticulata, parietibus crassis, fusce brunnea, 40μ ($31-53$) diam.; oosporae fere implentes oogonium, sphaericae, levibus parietibus ornatae, brunneae 33μ ($25-42$) diam.; antheridium ut plurimum unum in singulis oogoniis, paragynum $16 \times 12 \mu$ hyalinum; oosporae germinantes in maturitate, producentes unum sporangium in apice tubuli germinationis.

On living leaves and leaf-sheath of *Cyperus bulbosus* Vahl.,
Coimbatore, 10-11-1952, K. V. Seethalakshmi.

[Spots irregular, indefinite, brown, amphigenous; hyphae intercellular, branched; sporangiophores emerging through the stomata, not branched, or sympodially branched, thin; sporangia obpyriform, papilla broad, $40 \times 25 \mu$ ($23-50 \times 20-34$), germinating by the production of zoospores or germ tubes; oogonia formed in the air cavities of the leaf sheath, spherical, reticulate, with a thick wall, dark brown, 40μ ($31-53$) diameter; oospores almost filling the oogonium, spherical, furnished with a smooth wall, brown 33μ ($25-42$) diameter; antheridium mostly single for each oogonium, paragynous $16 \times 12 \mu$ hyaline; oospores germinating at maturity, producing one sporangium at the apex of the germ tube.]

PHYTOPHTHORA CYPERI-IRIAE Sawada in Rep. Govt Res. Inst. Taihoku 51, p. 13, pl. 1 (figs. 13-16), March 1931. [Japanese.]

≡ *Kawakamia cyperi-iriae* (Sawada) Sawada in *Agric. Mag. Formosa*, 38, 5, p. 351, 1942.

Maculis in foliis petiolisque primo fulvis dein brunneis; hyphis intercellularibus, $3.5-5 \mu$ latis, haustriis ovoideis instructis; conidiophoris e stomatibus erumpentibus, brevibus, tenuibus, non ramosis; sporangiis ovoideo-ellipsoideis, basi rotundatis, papilla depressa ornatis, $49-62 \times 29-33 \mu$, per-zoosporas germinantibus oogoniis inter cellulas hospitis, sphaericis, luteo- vel fusco-brunneis, $35-50 \times 29-46 \mu$, membrana $2-3 \mu$ crassa; antheridiis plerumque paragenis vel raro amphigenis, obovoideis vel ellipsoideis, $17-23 \times 12-17 \mu$, oosporis sphaericis, brunneolis, $25-43 \mu$ diam., episporio levi, $1.3-5 \mu$ crasso tectis.

Hab. in foliis petiolisque *Cyperi iriae* L. in Formosa.

[Spots on leaves and petioles yellowish-brown to brown, intercellular hyphae, $3.5-5 \mu$ broad, ovoid haustoria; conidiophores bursting from stomates, very small, thin, non-branching; sporangia ovoid-ellipsoid, round base, depressed papilla, $49-62 \times 29-33 \mu$, germinating by zoospores within the cells of the host, oogonia round, yellowish- or dark-brown, $35-50 \times 29-46 \mu$, membranes $2-3 \mu$ thick; antheridia mostly paragynous rarely amphigynous obovoid or ellipsoid, $17-23 \times 12-17 \mu$, round oospores brown, $25-43 \mu$ in diameter, smooth episporous, $1.3-5 \mu$ thick walled.

Hab. on leaves and petals of *Cyperus iria* in Formosa.]

[Latin diagnosis given by S. Ito & Y. Tokunaga in *Trans. Sapp. nat. Hist. Soc.*, 14, 1, p. 14, 1935.]

PHYTOPHTHORA CYPERI-ROTUNDATI Sawada in Rep. Govt. Res. Inst. Taihoku 27, pp. 26-28, pl. II (figs. 20-25), September 1927. [Japanese.]

≡ Kawakamia cyperi-rotundati (Sawada) Sawada in Agric. Mag. Formosa, 38, 5, p. 351, 1942.

Maculis foliicolis, ellipticis, oblongo-elliptis vel elongatis, margine pallide luteo-auranticis, medio brunneo-auranticis; hyphis intercellularibus, 3-7 μ latis, haustriis obovoideis instructis; conidiophoris e stomatibus exeuntibus, usque ad 30 μ longis, simplicibus vel raro sympodice ramosis; sporangiis oblongo-ovoideis, basi rotundatis vel attenuatis, 22-67 $\times$ 14-34 μ [average in the original paper 45.4 $\times$ 25.1 μ], per zoosporas vel per tubum germinantibus; oogoniis in parenchymate foliorum sphaericis, brunneis, leptodermis, 31-47 $\times$ 25-45 μ ; antheridiis paragenis vel amphigenis, obovoideis vel subsphaericis; oosporis sphaericis, hyalinis vel brunneolis, aploeroticis, 22-39 μ diam., episporio levi, 1-3 μ crasso tectis.

Hab. in foliis Cyperi rotundati L. in Kyushu, Formosa.

[Spots on leaves, elliptical, oblong-elliptic or elongated, pale yellowy-gold at the edges, brownish-gold in the middle; intercellular hyphae, 3-7 μ broad, obovoid haustoria; conidiophores sent out through the stomates, up to 30 μ long, simple or rarely sympodially branched; sporangia oblong-ovoid, base round or attenuate, 22-67 $\times$ 14-34 μ , germinating through zoosporas or tube; oogonia round in parenchyma of the leaves, brown, beneath the dermis, 31-47 $\times$ 25-45 μ ; paragynous antheridia or amphigynous, obovoid or subspherical; round oospores, brownish or hyaline, aploerotic, 22-39 μ in diameter, smooth epispores, 1-3 μ thick wall.]

Hab. in leaves of Cyperus rotundus.]

[Latin diagnosis given by S. Ito & Y. Tokunaga in Trans. Sapp. nat. Hist. Soc., 14, 1, p. 15, 1935:]

BOTRYTIS DEVASTATRIX Libert in Organe de Flandres, 19th August 1845.

[Original not seen.]

PERONOSPORA DEVASTATRIX (Libert) Caspary in Verh. Preuss. Akad. Wiss. Berlin, 3, p. 325, May 1855.

Caespitibus laxis albidis; stipitibus liberis gracillimis, subflexuosis, $\frac{1}{8}$ - $\frac{1}{4}$ ''' altis, proprie ramosis, ramis tantum primi ordinis, numero 2-5, elongatis, attenuatis, plerumque semel — ter nodosoincrassatis. Acrosporis ovatis, apice saepe apiculatis, $\frac{1}{133}$ - $\frac{1}{165}$ ''' altis, $\frac{1}{123}$ - $\frac{1}{75}$ ''' longis, granulis pellucidis incoloratis fartis.

In foliis, caulibus, tuberibus, fructibus vivis et sanis Solanum tuberosi.....

[In loose white tufts; stalks free, slender, subflexuose, $\frac{1}{8}$ - $\frac{1}{4}$ ''' high, peculiarly branched, branches of the first order 2 to 5 in number, elongated, attenuated and mostly once to thrice nodosely swollen. Acrospores ovate, apices often apiculate, $\frac{1}{133}$ - $\frac{1}{165}$ ''' high, $\frac{1}{123}$ - $\frac{1}{75}$ ''' long, filled with transparent colourless granules.]

In leaves, stems, tubers, fruits living and healthy of Solanum tuberosum.]

PHYTOPHTHORA DEVASTATRIX (Libert) Puttemans in Rodriguésia, 2 (1936), num. esp., p. 349 [? 1937].

≡ Botrytis devastatrix Libert [q. v.]

≡ Peronospora devastatrix (Libert) Caspary [q. v.]

Claimed as a prior name for P. infestans.

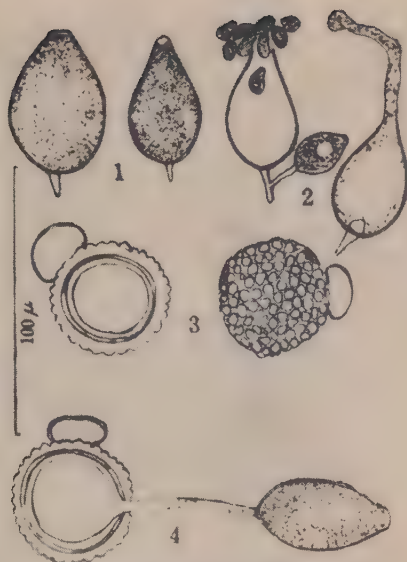


100 μ

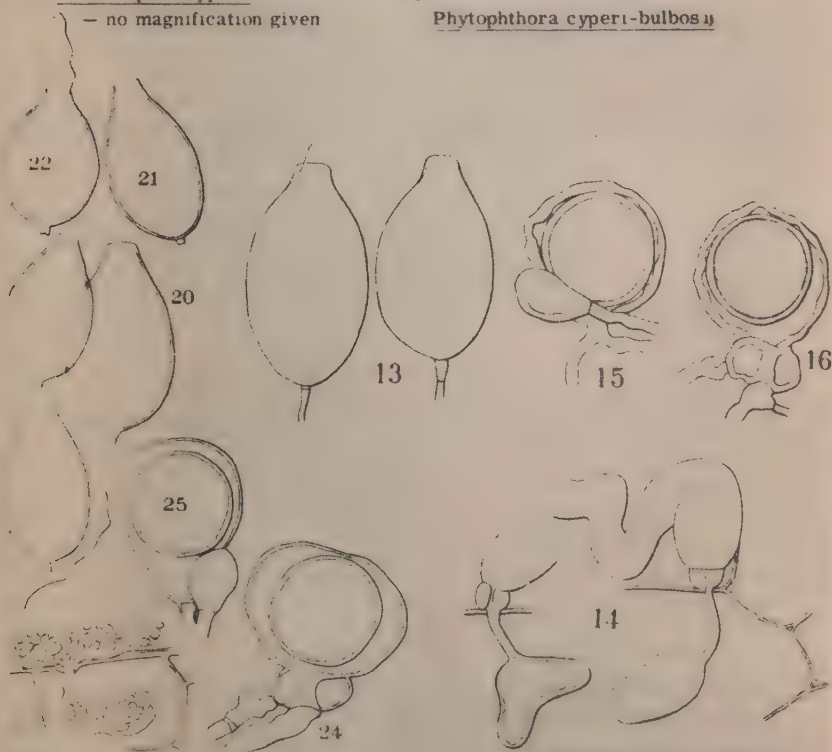


Peronospora cyperi

— no magnification given



Phytophthora cyperi-bulbosus



Phytophthora cyperi-rotundati

— figs. 20-22, 24-25, $\times 405$; 23, $\times 940$

Phytophthora cyperi-iriae

— figs. 13, 15, 16, $\times 405$; 14, $\times 940$

PHYTOPHTHORA DRECHSLERI Tucker in Res. Bull. Mo. agric. Exp. Sta. 153, p. 188, figs. 2-3, June 1931.

≡ P. erythroseptica var. drechsleri (Tucker) Sarejanni [q. v.]

Hyphae continuous when young, becoming septate with age, similar to those of other Phytophthoras; vegetative growth luxuriant on steamed corn meal, potato dextrose agar, oatmeal agar, etc.; sporangia rare on the solid media used; in Petri's mineral solution sporangia developing more frequently, non-papillate, ovate, pyriform to obpyriform $24-38 \times 15-24 \mu$ (average of 50 sporangia $31.4 \times 21 \mu$), germinating by germ tubes or zoospores; sporangiophores slightly smaller in diameter than the hyphae, usually simple with a single terminal sporangium, resuming growth through the base of the evacuated sporangium and producing new sporangia within or beyond the walls of the empty one; true chlamydospores not observed, but swollen irregular vesicles superficially resembling chlamydospores sometimes developing terminally on the hyphae; oogonia broadly clavate to subspherical, hyaline to light amber, smooth, $21.7-53.4 \mu$ (average 31.3μ); oospores spherical, smooth, hyaline to lemon-coloured, contents granular, $16.7-45.1 \mu$ (average 25.6μ); antheridia amphigynous, penetrated by the oogonial stalk, persistent, subspherical to irregular, variable in size.

On corn meal agar (pH 6.2) the optimum temperature for vegetative growth is between 30°C . and 32.5° . Growth occurs at temperatures between 10° and 37.5° .

Known only from the type isolated by Charles Drechsler from rotting tubers of Solanum tuberosum L. from Idaho, U.S.A.

PHYTOPHTHORA ERYTHROSEPTICA Pethybridge in Sci. Proc. R. Dublin Soc., N.S., 13, 35, p. 547-8, pl. 43, figs. 9-10, pl. 44, March 1913.

Mycelio ramoso quoad partes recentiores non septato quoad vetustiores multiseptato vacuatoque conidiis inversipyriformibus aut propemodum ovoideis sympodialiter genitis $32 \mu \times 20 \mu$ antheridiis terminalibus aut lateralibus aut intercalariis rotundis aut ovoideis penetratis ad vel iuxta bases suas oogoniis incipientibus quae deinde ex partibus summis emergunt oogoniis pyriformibus super hyphas quae origine distant ab illis hyphis quae illa antheridia gignunt partes inferiores intra antheridia superiores autem in summis antheridiis habentibus oosporis sphaericis crasso subfuscis episporio praeditis $29 \mu - 30 \mu$. Invenitur inter tuberis cellulas Solani tuberosi quas enecat. Hae cellulae tubere secto ad aerem nudatae colorem primo rubescentem postea prope nigrescentem prae se ferunt.

Hab. in Hibernia hesperia et boreali.

[Mycelium branched, non-septate in the recent parts multiseptate and vacuolate in the older parts; conidia obpyriform or nearly ovoid, sympodially produced, $32 \times 20 \mu$; antheridia terminal, lateral or intercalary, round or ovoid penetrated at or near its base by the oogonial initial, which emerges from the part at the apex; oogonium pyriform on a hypha which arises at a distance from the hypha which gives rise to the antheridium, lower part inside the antheridium, but the upper part on top of the antheridium; oospores spherical with a thick dark episporio, $29-30 \mu$. Found between the tuber cells of Solanum tuberosum which it damages. When the cells of the cut tuber are exposed to the air they become coloured first reddish then later nearly black.

Hab. in north and west Ireland.]

PHYTOPHTHORA ERYTHROSEPTICA var. ATROPAE Alcock in Pharm. J., 116, 3254, p. 232, ?February 1926.

By Dr. Malcolm Wilson's advice we are naming this fungus provisionally Phytophthora erythroseptica var. atrophae, a new variety, and the reasons for making it a new variety are as follows:- (1) it does not attack potatoes in the



FIGURE 2

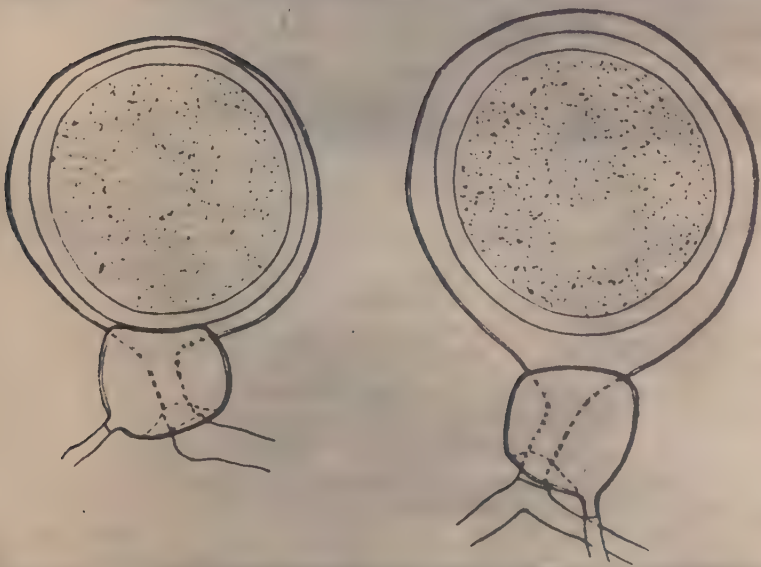


FIGURE 3

Phytophthora drechsleri — fig. 2, $\times 600$; fig. 3, $\times 1,400$

field; (2) it is primarily a stem rot; (3) it forms oospores in quantity in situ, occurring in the lower parts of the dying stems. P. erythroseptica forms them exceedingly rarely in the potato tuber or haulm; (4) the sporangia are larger, averaging 48×30 , whereas those of P. erythroseptica are 32×20 ; (5) although the Phytophthora from atropa will grow on fresh potato tubers, the pink flush that characterises P. erythroseptica does not appear.

In Atropa belladonna [in Scotland].

PHYTOPHTHORA ERYTHROSEPTICA var. DRECHSLERI (Tucker) Sarejanni in Ann. Inst. phytopath. Benaki, 2, 1, p. 48, 1936 [?1937].

Nomen nudum.

PHYTOPHTHORA FABERI Maublanc in Agric. prat. Pays chauds, 9, 79, p. 315, pl. 53 (figs. 1-4), October 1909.

Taches irrégulières, brunes; spores blancs ou jaunâtres peu visibles; conidio-phores longs de 150μ à 200μ , continus, hyalines et terminés par une conidie apicale, plus rarement rameux et portant 2 conidies; conidies (sporangies) de forme variée, généralement en citron, à membrane mince, lisse, un peu épaissie au sommet, $30-80 = 25-42 \mu$; oospores arrondies, lisses, à membrane épaisse, 45μ de diamètre.

Parasite sur les fruits du Cacaoyer dans les régions Chaudes.

Distinct du P. cactorum (Cohn et Leb.) Schr. par la dimension des oospores et le moins grand nombre des zoospores produite à la germination des conidies.

[Spots irregular, brown; spores small, white or yellow, conidiophores $150-200 \mu$ long, continuous, hyaline, terminating apically, or rarely branched and bearing 2 conidia; conidia varying in shape, usually citriform, thin-walled, smooth, slightly thickened at the top $30-80 \times 25-41 \mu$, oospores rounded, smooth, thick-walled, 45μ in diameter.

Parasitic on fruits of Cacao tree in hot regions.

Distinct from P. cactorum by the size of the oospores and smaller number of zoospores produced by germination of conidia.]

PERONOSPORA FAGI Hartig in Zeit. Forst.-Jagd w., 8, pp. 121-122, 1876.

Die Krankheit wird erzeugt durch einem Parasiten, welcher zunächst verwandt ist mit der Peronospora infestans, welcher Pilz bekanntlich die verderbliche kartoffelkrankheit hervorruft. Da derselbe bisher nicht beschrieben worden ist, so dürfte der Name Peronospora fagi angemessen erscheinen. Der Parasit vollendet seinen ganzen Entwicklungsverlauf in den noch völlig grünen Samenlappen der Rothbuchen, wird aber auch auf die jungen Plumualblätter dieser Pflanze übertragen.

Die dicken, farblosen Mycelfäden scheinen nur intercellular zu sein und auch die im Innern des Blattes entstehenden Fructificationsorgane scheinen lediglich zwischen den Zellen sich auszubilden. Die sporen, welche der Parasit erzeugt, sind verschiedenartiger Natur. Zuerst entstehen an kurzen Mycelfäden, welche aus den Spaltöffnungen hervorwachsen, aber auch die Epidermis durchbohren. Sporangien von birnformiger Gestalt, eine Länge von ca. 40 Mikm., eine Breite im oberen Drittel von ca. 25 Mikm. Dieselben fallen sehr leicht ab und zeigen dann einem kleinen enlindrischen [cylindrischen] Fortsatz an der Basis.

Während nun die Sporangienbildung ausserhalb der Blättern vor sich geht, entstehen in Innern derselben durch Anschwellung zahlreichen Mycelenden die weiblichen Oogonien in Gestalt kugelförmiger, plasmareicher, dickwandiger Zellen von ca. 20 Mikm. Durchmesser. An jeder dieser Oogonien legt sich ein Mycelfaden an, welcher keulenförmig anschwillt zu dem männlichen Anth-

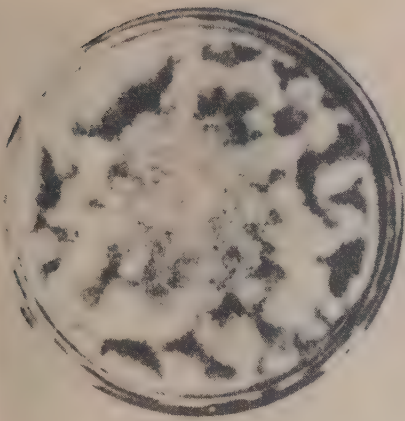


FIGURE 9

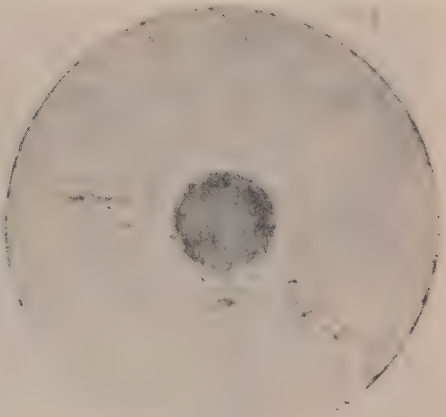


FIGURE 10



Phytophthora erythroseptica — figs. 9, 10, no magnification given;
figs. 11-16, 18, 21, $\times 625$; 17, 19-20, $\times 425$

eridium. Dieses verwächst mit dem weiblichen Organe und tritt nunmehr der Inhalt des männlichen Organes in das weibliche Organ über. In Folge dieses Befruchtungsaktes entsteht in dem Oogonium die sehr dickwandige Eispore, welche durch Platzen der Wandung des Oogoniums leicht frei wird.

[The disease is caused by a parasite which is nearly related to Peronospora infestans, the well-known fungus which produces the dangerous potato disease.

As this one has not so far been described, the name Peronospora fagi appears suitable. The parasite completes its whole developmental process in the yet fully green seed lobes of the copper beech, but is also carried into the young plumule leaves of these plants.

The thick colourless mycelial threads appear to be only intercellular, and developing fructification organs, also in the interior of the leaves, appear to form only between the cells. The spores, which the parasite produces, are of different kinds. The first develop on short mycelial threads which grow out of the stomata but also bore through the epidermis. Sporangia of pear-shaped form, with a length of ca. 40 μ , a breadth in the upper third of ca. 25 μ fall off very easily and then show a small cylindrical process at the base.

Whereas only the sporangial structures occur on the outside of the leaves, there develop in the inside of these by the swelling of numerous mycelial ends, the female oogonia in the shape of spherical cells rich in protoplasm, thick-walled, and ca. 20 μ across. To each of these oogonia is applied a mycelial thread, the club shape of which swells into the male antheridium. This grows closely with the female oogonium and by that time the contents of the male organ flow over into the female organ. In consequence of this fertilization process, the very thick-walled oospore develops in the oogonium, which through the splitting of the oogonial wall is easily set free.]

PHYTOPHTHORA FAGI (Hartig) Hartig in Forstwiss. Zbl., 1, pp. 162-163, 1879.

≡ Peronospora fagi Hartig [q. v.]

≡ Nozemias fagi (Hartig) Pethyb. [see above, under Nozemias]

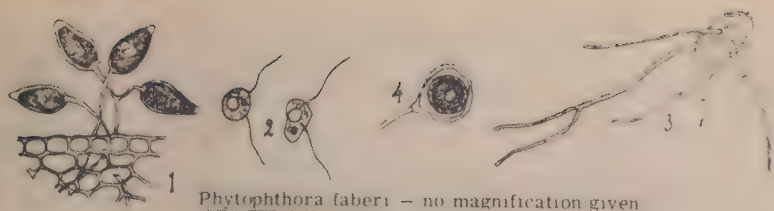
≡ Phloeophthora fagi (Hartig) Wilson [see above, under Phloeophthora]

Diese Krankheit wird erzeugt durch einem parasitischen Pilz, den ich bei meiner ersten Veröffentlichung Peronospora Fagi genannt habe, und welcher der nächste Verwandte des bekannten Kartoffelfaulepilzes, der Peronospora infestans, ist. Seitdem hat nun de Bary aus der Gattung Peronospora den genannten Kartoffelpilz als besondere Gattung mit dem Namen Phytophthora abgezweigt, und da die für diese neue Gattung ausgestellte Diagnose auch auf den Buchenkeimlingspilz gilt, so muss derselbe in der Folge Phytophthora Fagi genannt werden.

[This disease is caused by a parasitic fungus, which in my first publication I called Peronospora fagi, and which is a close relative of the well-known potato blight fungus, Peronospora infestans. Since then, De Bary has now separated off from the genus Peronospora the named potato fungus as a special genus with the name Phytophthora, and as the diagnosis set out for this new genus is also the main feature of the beech seedling fungus, so it must in consequence be named Phytophthora fagi.]

PHYTOPHTHORA FAGOPYRI Takimoto in Bult. sci. Fak. terk. Kjušu Univ., 6, 2, p. 108, pl. II (figs. V-IX), February 1953. [Japanese]

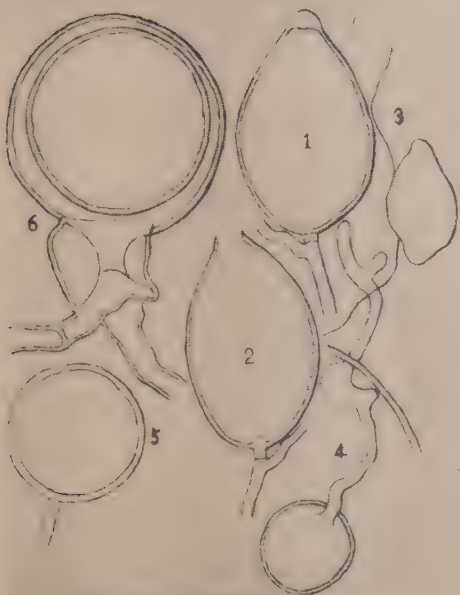
Internal mycelium irregularly swollen, with granular contents, hyaline, aseptate, 10-12 μ in diameter; aerial mycelium on the infected tissue slender, uniform in diameter and homogeneous in content, 4-5 μ in diameter. Conidia not formed on the host, but are numerous on artificial medium, globose, elliptic or ovate, with prominent papillae and granular contents, hyaline, 35-45 $\times$ 24-35 μ , germinating by germ-tubes. Oogonia formed in old infected tissues, steamed bean pod, oatmeal agar and maize meal agar, globose, yellowish-brown, 25-40 μ (on host) or 36-40 μ (oat meal agar) in size; antheridia paragynous, clavate, declinuous.



Phytophthora faberi — no magnification given



VII



Phytophthora formosana

— figs. 1, 2, 5, $\times 450$; 3, 4, 6, $\times 940$



VIII



IX

Phytophthora fabryi — figs V-IX.

no magnification given

Infecting stem, crown, and root of buckwheat, causing death.
Collections: Korea, 1915
Fukuoka, Japan, 1933

[From a translation of the original by Dr. C. T. Wei. No Latin diagnosis.]

PHYTOPHTHORA FICI Hori in J. Pl. Prot. Tokyo, 2, 11, pp. 931-932, November 1915. [Japanese]

Aerial mycelium cotton-woolly, with occasional septa; endomycelium large with no septa. Conidiophores 80-380 μ with characteristic swellings, sometimes as many as eight, near where the spores are attached; branches and septa rare. Conidia oval or elongated ellipsoid or oval; with a hemispherical papilla, a short pedicel, and occasionally a large central vacuole; 22-44 $\times$ 34-70 μ , a very slender one measuring 24 $\times$ 68 μ and a broad oval one 44 $\times$ 62 μ . With moisture the conidia divide up in two hours into 15 to 20 zoospores which at rest measure 8-10 μ in diameter. The conidium may germinate at the summit by a tube with another conidium at the apex. Spherical, slightly yellowish-brown chlamydospores, measuring 26-28 μ with a wall 1.5-2 μ thick are common. Oogonium unknown.

Causing blight of fig fruits in the Shizuoka Prefecture, Japan, in 1911, and at the Gumma Agricultural Experiment Station in 1915. Also readily infects pears, apples, and persimmons on inoculation.

[From a translation of the original by Dr. Z. Hidaka.]

PHYTOPHTHORA FICI Venkata Rau in J. Bombay nat. Hist. Soc., 24, 3, p. 615, 20th June, 1916.

I have come across a disease of figs (Ficus carica) causing a soft rot, in Bangalore. . . . apparently new to science. I propose provisionally the name Phytophthora fici. A comparative study is being made in this Department when the question of nomenclature will be definitely settled.

PHYTOPHTHORA FORMOSANA Sawada in Agric. Magaz. Formosa, 38, 4, p. 253, 1942. [Japanese]

On castor bean plants, aerial mycelium 3-5 μ diam. forming septa later. Internal mycelium 6-8 μ diam. In water at 25°C. on unpolished rice medium conidia are formed terminally and sympodially or are intercalary. They are 20-58 $\times$ 16-44 μ (average of 300, 35.5 $\times$ 28.18 μ), with a mode at 33 $\times$ 28 μ and a l/d ratio of 1.26; papilla prominent. On egg-plant mycelium in water conidia 13-69 $\times$ 10-46 μ , averaging (188) 39.1 $\times$ 28.48 μ ; papilla 5-8 μ high usually one, rarely three. Zoospores ovate 12-15 $\times$ 8-9 μ , anterior flagellum 15-18 μ , the posterior one 19-22 μ ; at rest 10-12 μ diam. germinating by 8-3 germ tubes. Chlamydospores terminal or intercalary, globose, colourless to yellowish brown, with walls 1.5-2 μ thick and ranging from 14-49 μ on various media (average 24.7-39.1) with a mode ranging from 21 to 40 μ . They germinate by 1 or 2 germ tubes.

Oogonia globose, hyaline, containing one globose hyaline oospore; antheridia amphigynous. Oogonia 18-36 μ , average 23.8-30.3 μ mode 23-30 μ ; oospores 14-29, average 19-24.5 μ mode 19-25 μ ; antheridia 7-13 $\times$ 10-15 μ ; the oospores germinate by germ tubes terminated by conidia.

Parasitic on the leaves of Ricinus communis at Pingtung, Tainan Hsien, Formosa, 11.6.1922.

[From a translation by Dr. C. T. Wei of a reprint of the original in Rep. Gov. agric. Res. Inst., Formosa, 85, 1943. Figures in the same publication pl. I (figs. 1-6). No Latin diagnosis.]

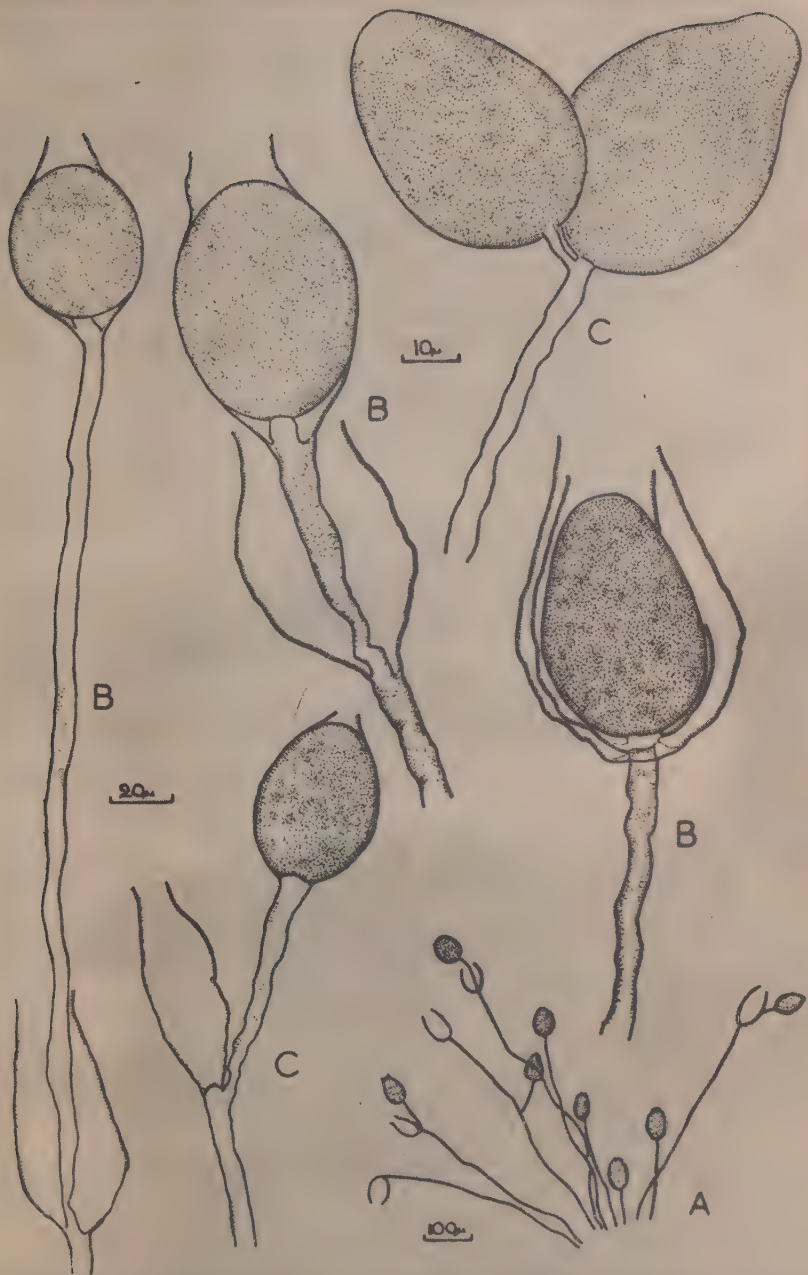


FIGURE 9

Phytophthora fragariae

PHYTOPHTHORA FRAGARIAE Hickman in J. hort. Sci. (formerly J. Pomol.), 18, p. 103, figs. 9, 10, June 1940.

Mycelium inter et intra cellulare. Sporangia acrogena, obverse pyriformia vel rarius ovoidea ellipsoidea, apice obtuse rotundata, $32-90 \times 22-52 \mu$ (in medio $60 \times 38 \mu$), membrana tenue ad apicem leviter incrassata instructa; germinatio per zoosporas, rarius per hyphas. Sporangiphora longitudine varia, per zoosporangia evacuata penetrantia et zoosporangia nova gignentia; aliquando zoosporangia secundaria in ramibus brevibus sub sporangio primario ipso orientibus gerentia. Oogonia praecipue in stelis evoluta, acrogena vel pleurogena, subpyriformia, $28-46 \mu$ (in medio 39μ) crasse tunicata, demum aureobrunnea. Antheridia acrogena vel rarius intercalaria, amphigyna, interdum paragyna, $16-30 \times 12-22 \mu$ (in medio $22 \times 16 \mu$) aliquando breve diverticulata. Oospores globosae, subglobosae vel ellipsoideae, $24-44 \mu$ diam. (in medio 33μ), hyalinae, membrana leve circa 3μ crassa.

Hab. In radicibus caulibusque Fragariae cult., Britannia.

Mycelium hyaline, non-septate or sparingly so in older parts, inter- and intracellular, Sporangia terminal, developed on undifferentiated sporangiophores $10-800 \mu$ long; in shape usually inversely pyriform, less commonly ovoid or ellipsoidal; non-papillate with bluntly rounded apex, $32-90 \times 22-52 \mu$ (average $60 \times 38 \mu$); wall thin with slight apical thickening; germinating by zoospores, rarely by germ tube. Further sporangia formed, each within or beyond and empty one by renewed growth of the sporangiophore through the base of the original sporangium; less often in sympodial fashion on a short lateral branch arising immediately beneath the original sporangium. Sexual organs developed most abundantly in the vascular tissue. Oogonia terminal or lateral, commonly globose with funnel-shaped base, $28-44 \mu$ (average 39μ) in diameter; becoming golden brown with age. Antheridia terminal (rarely intercalary) amphigynous or less commonly paragynous; $16-30 \times 12-22 \mu$ (average $22 \times 16 \mu$) sometimes provided with short hyphal projections. Oospores spherical, subspherical or more irregular in shape, lying free within the oogonium; $22-44 \mu$ (average 33μ) in diameter when spherical; hyaline, possessing a thick (3μ) smooth wall.

Hab. In the roots and rootstock of cultivated strawberries in England and Scotland.

PYTHIOMORPHA GONAPODYIDES Petersen in Bot. Tidsskr., 29, 4, p. 391, figs. VI, VII, December 1909; English version in Ann. Mycol., 8, 5, p. 528, October 1910.

Mycelium intramaticale ramosum irregulariter turmoribus et parietibus undulatis instructum. Mycelium extramaticale hyphis erectis non ramosis diam. $4-5 \mu$ constat. Zoosporangia terminalia ovalia diam. c. $44 \times 22 \mu$. Zoosporae ut in Saprolegnia non vesica cinctae, ellipsoideae, duobus ciliis lateralibus munitae, diam 10μ exeunt.

Hyphae in et per zoosporangia evacuata penetrant et nova sporangia repetite formant. Oogonia et antheridia non observata. Chloreto zinc. iodato hyphae colorem rubro-violaceum accipiunt. In fructibus dejectis submersis Pyri Mali et ramulis dejectis Alni sp.

[Intramatricul mycelium irregularly branched, composed of swellings and undulating walls. Extramatricul mycelium consisting of erect non-branched hyphae $4-5 \mu$ in diameter. Zoosporangia terminal, oval, $44 \times 22 \mu$ in diameter. Zoospores as in Saprolegnia, coming out not encircled by a vesicle, ellipsoid, furnished with two cilia, diameter 10μ .

Hyphae penetrating in and through evacuated sporangia and forming new sporangia by repetition. Oogonia and antheridia not seen. With chlor-zinc iodate the hyphae take on a red-violet colour.

In fallen submerged fruits of Pyrus malus and fallen branches of Alnus sp.]

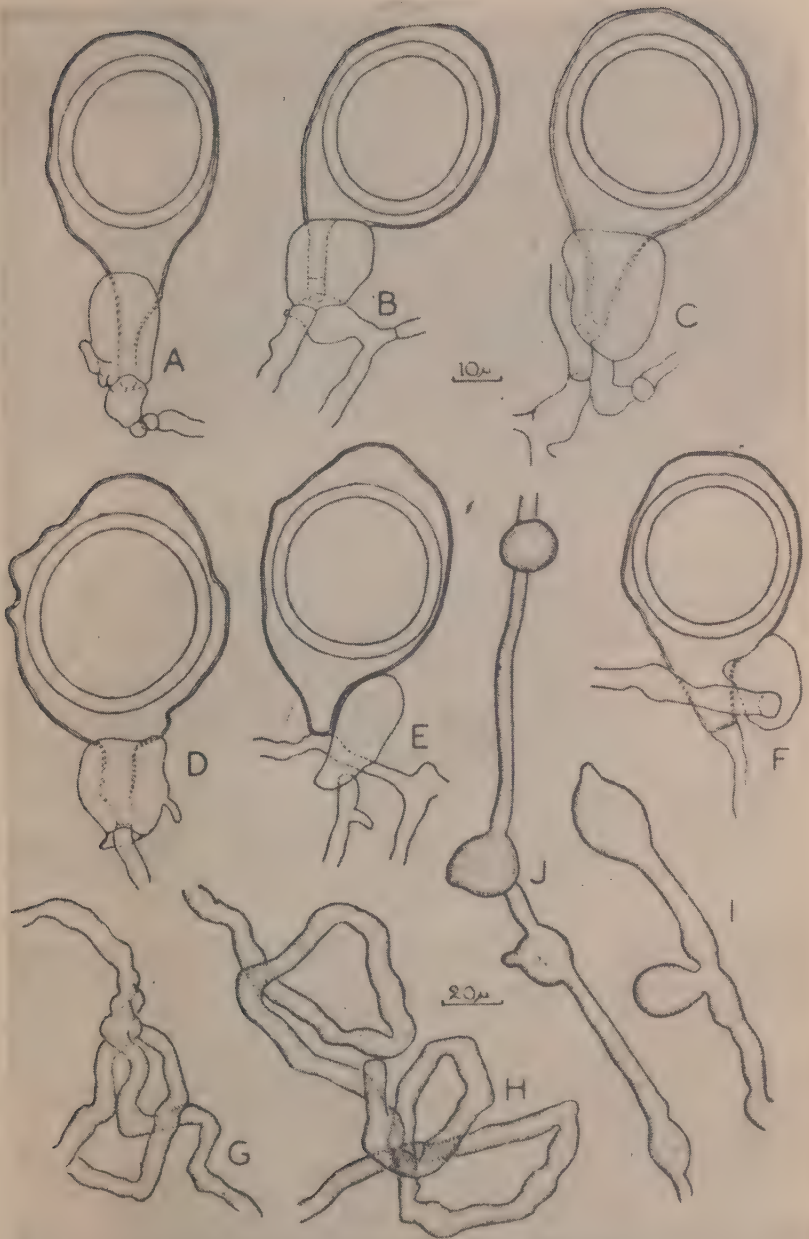


FIGURE 10

Phytophthora fragariae

PHYTOPHTHORA GONAPODYIDES (Petersen) Buisman in Meded. phytopath.
Lab. Scholten 11, p. 7, May 1927; reprinted as Proefschrift Universiteit
Utrecht, Haarlem, 1927.

I think that I have now shown that the genera Blepharospora and Pythiomorpha should be included in the genus Phytophthora, so that we may speak of Phytophthora cambivora and Phytophthora gonapodyides.

PHYTOPHTHORA HEVEAE Thompson in Malay. agric. J., 17, 3-4, p. 77, pl. ID, March-April 1929.

Mycelium submerged on agar media, and not formed on potato blocks, non-septate when young, 2-7 μ in width. Sporangia present on most agar media, and in water culture to which a seed of Vigna catjang is added, but absent or few in number on potato agar, somewhat irregular in shape, varying from spherical to narrowly ovate; sporangiophore frequently inserted laterally. Range of sporangia 27-66 $\times$ 20.5-48 μ , average of 400 45.9 $\times$ 29.62 μ . Mean ratio of length to width = 1.55. Oogonia and oospores freely formed on potato dextrose and agar media and also in water. Oogonia broadly funnel shaped with amphigynous antheridia. Oospores round, smooth, and thick walled, not always coloured distinctly. Range of 200 oogonia = 17-32 μ , mean = 25.91 μ , range of 250 oospores = 15-26.8 μ , mean = 21.46 μ .

Parasitic in Malaya on bark and fruit of Hevea brasiliensis (H. B. K.) Muell. Arg. Para Rubber.

PHYTOPHTHORA HIBERNALIS Carne, in J. roy. Soc. W. Austr., 12, p. 36, pls. III, IV, V (A, B), December 23, 1925.

Mycelio ramoso irregulariter, hyalino, ex hyphis primo continuis tandem septatis, 3-12 μ plerumque 5 μ crassis, inter et intra-cellularibus; conidiophoris unicis et sustinentibus onidium unum in apice; conidiis ellipsoidalis, papillatis, 17-56 $\times$ 10-28 μ deciduis, cum pedicellis persistentibus, saepe formatibus zoosporangia; zoosporis reniformis biciliatis 11 $\times$ 9 μ ; oogonis subglobosis, hyalinis, 22-56 μ longis, levibus sed vestitioribus rugosis; antheridiis persistentibus, hyalinis, ovoideis, levibus, amphigynis raro paragynis; oosporis sphaericis hyalinis vestitioribus luteis, 22-45.6 μ .

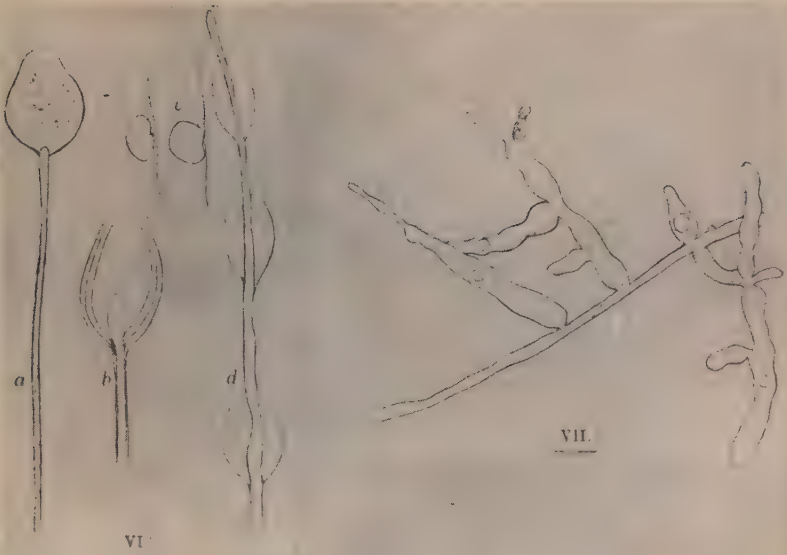
Hab. in fructibus, foliis, ramis Citri spp. in Western Australia, South Australia et probabiliter Victoria, Queensland et Regionis Mediterranae.

Mycelium irregularly branched, hyaline; hyphae at first continuous, somewhat septate and often empty when old, 3-12 μ in width usually 5 μ , inter or intracellular conidiophores simple bearing a single terminal conidium; conidia elliptical papillate 17-56 $\times$ 10-28 μ , deciduous with very persistent pedicels 2-56 μ long, often germinating as zoosporangia; zoospores reniform, biciliate, 11 $\times$ 9 μ germinating by germ tubes; oogonia hyaline, subglobose, 22-56 μ in length, at first smooth, but later forming a rough covering on the oospore; antheridia persistent, hyaline, ovoid, smooth, amphigynous, rarely paragynous; oospores spherical, 22-45.6 μ yellow to tawny when mature.

Hab. On fruit, leaves and smaller branches of Citrus spp. Western Australia, South Australia and probably Victoria, Queensland, and the Mediterranean Region.

PHYTOPHTHORA HIMALAYENSIS Dastur in Indian Phytopath., 1, 1, pp. 24-25, figs. 1-6, 1948.

Discolorationes in epidermide tuberum nigrae, in partibus infectis inferioribus pallide brunneae et rubiginoso-brunneae, post ad aerem patefactae colorem ad roseum haud mutantes; quam illae a Phytophthorae infestantis productae profufundiores. Mycelium ex hyphis inter- et intra-cellularibus com-



Pythiomorpha gonapodyides — fig. vi, no magnification given; vii, $\times c. 200$

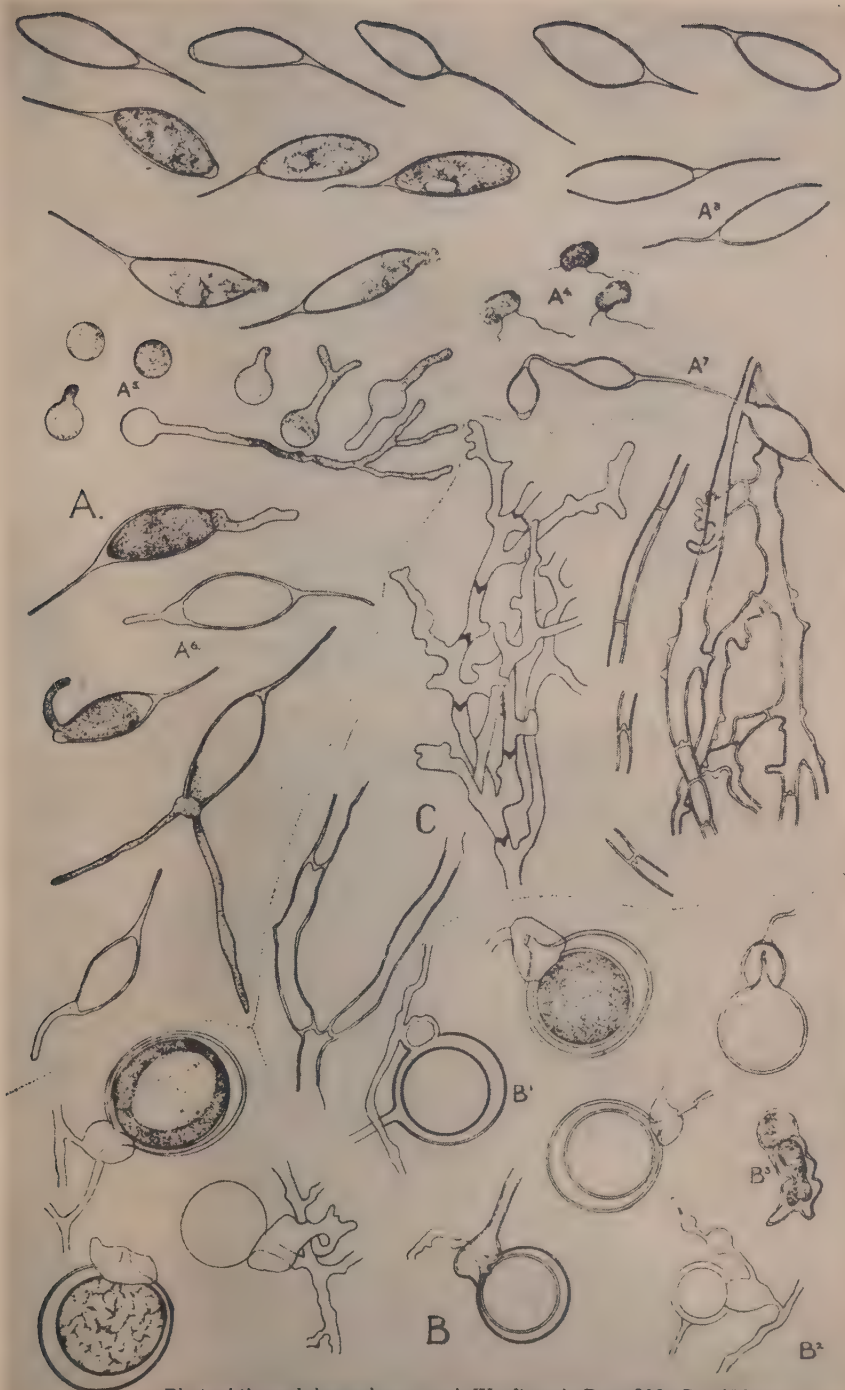


Phytophthora heveae — no magnification given



PLATE III

Phytophthora hibernalis — pl. III — no magnification given



Phytophthora hibernalis — pl. IV, figs. A, B, $\times 500$; C $\times 400$

positum. Sporangiophora specialia nulla. Sporangia in planta hospite non visa, sed in culturis ad formicas in aquo sterilisatas evoluta; $29.0-50.0 \times 22.0-36.0 \mu$, papilla latissima et inconspicue eminenti, $8.5-13.0 \times 2.5-5.0 \mu$ ornata; zoosporis carentia, et ita ut conidia germinantia. Chlamydosporae nullae, et in planta hospite et in culturis absentes. Sporae sexuales in medio nutritivo profuse —, etiam in planta hospite nonnihil-, productae, hyalinae, sed in superficie incisa tuberis solanacei brunneae vel melleae; et antheridia et oogonia hyphis vel singulis vel diversis insidentia. Antheridia amphigyna. Oogonia pariete tenui praedita, laevia globosa vel globioidea, $19.0-50.0 \mu$ diam., (post 100 mensurationes medietas erat 35.26μ .) Oosporae globosae, laeves, pariete haud crasso praeditae, colore luteo raro aspersae, cavitatem oogonialem fere omnino implentes, $15.0-45.0 \mu$ diam.: (post 100 mensurationes medietas erat 31.0μ).

Hab. in tuberibus Solani tuberosi Linn.: Kufri, Simla Hills, Indiae Julio, 1945 et 1946.

Causing black discoloration on the skin of the tubers; diseased tissues light brown to rusty brown, not turning pink on exposure to air; infection deeper in the tuber tissues than in *Phytophthora infestans*, mycelium inter- and intracellular; haustoria lacking; sporangia not seen on host; in cultures produced only on sterilized ants in water, $29-50 \times 22-36 \mu$; papilla very broad and very slightly raised, $8.5-13 \times 2.5-5 \mu$; sporangia germinating conidially; zoospores not developed; special sporangiophores absent; chlamydosporae on host or in nutrient media absent; profuse development of sexual spores in nutrient media; formed also on host; sexual spores on nutrient media and host hyaline in colour but on cut surface of potato tuber brown or honey-coloured; antheridia amphigynous; oogonia smooth and thin-walled, globular or globoid, $19-50 \mu$ in diameter; the average of 100 measurements being 35.26μ ; antheridia and oogonia borne on the same hypha or on different hyphae; oospores globular, smooth and not thick-walled, rarely tinted yellow, almost filling the oogonial cavity, $15-45 \mu$, the average of 100 measurements being 31μ .

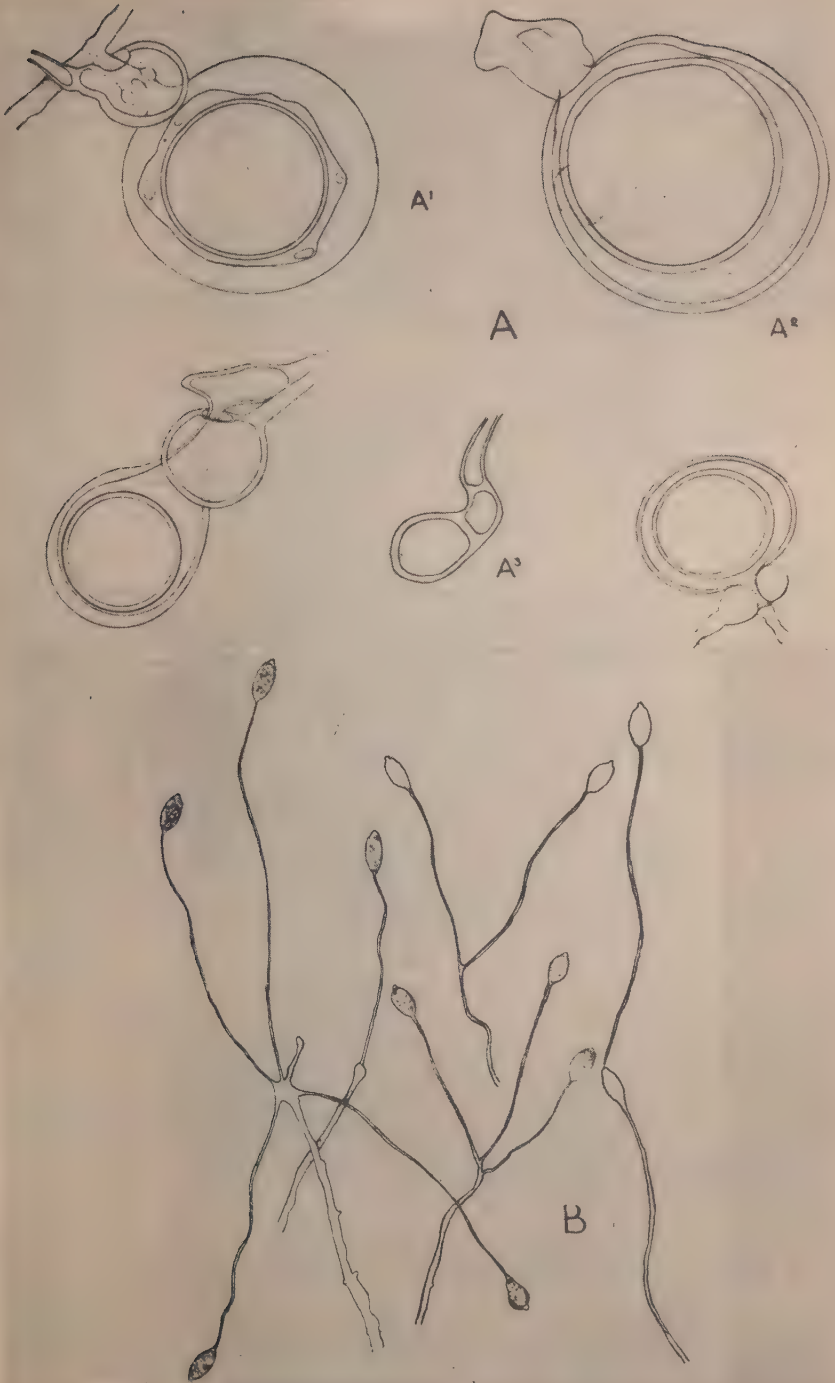
Hab. in tubers of *Solanum tuberosum* L. Kufri, 8,000 ft. (Simla Hills), India. July 1945 and 1946, leg J. F. Dastur.

PHYTOPHTHORA HYDROPHILA Curzi in *Riv. Pat. veg.*, Pavia, 17, 1-2, pp. 1-19, figs. 1, 2, Jan.-Feb. 1927.

Mycelio juvene continuo deinde septato, $4-8.5 \mu$ diam., inter et intra cellulari, interdum haustoriis sparsis et variis; hyphis sporangiophoris parum hyphis ordinariis dissimilibus; zoosporangiis terminalibus, papillatis, zoosporas ordinarie gignentibus, hyalinis: in aqua genitis (idrozoosporangia) hyphis fructiferis stabili modo haerentibus, saepe obpyriformibus, $50-95 \times 30-50 \mu$, extraordinarie unum v. plures tubos germinativos ex papilla erumpentes gignentibus; in aere ortis (aërozoosporangia) caducis brevi portione hyphae fructiferae semper haerente, saepe limoniformibus, $30-60 \times 22-36 \mu$, extraordinarie plurimos tubos germinativos parietem zoosporangii undique perforantes efficientibus; zoosporis ellipsoideis, asymmetricis, si quiescentibus sphaericis, $8-10 \mu$ diam.; oogoniis sphaericis, $28-35 \mu$ diam.; antheridiis amphigenis, ordinarie sub-ovoidalibus, $16-22 \times 12-15 \mu$, hyalinis; oosporis globosis, $24-29 \mu$, membrana levi, mellea, pariete flavo-brunnea et crispa oogonii indutis.

Hab. in caulibus Capsici annui morbo "cancrena pedale" affectis, in Italia meridionali et boreali.

[Mycelium continuous when young then septate, $4-8.5 \mu$ in diam., inter and intracellular, haustoria sparse and variable; hyphae and sporangiophores usually quite similar; zoosporangia terminal, papillate, usually producing zoospores, hyaline; in water hyphae bear fixed fructifications (hydrozoosporangia), often obpyriform, $50-95 \times 30-50 \mu$, occasionally one or several germ tubes breaking through the papilla; the aerial fructifications (aërozoosporangia) falling with a short portion of the hypha always, often limoniform, $30-60 \times 22-36 \mu$, occasionally several germ tubes perforate the wall of the zoosporangia on all



Phytophthora hibernalis pl. V, A, $\times 700$; B, $\times 175$

sides; zoospores ellipsoid, asymmetrical, spherical when at rest, 8-10 μ in diam.; antheridia amphigynous, usually subovoid, 16-22 $\times$ 12-15 μ , hyaline; oospores globose, 24-29 μ , thin-walled, honey coloured, wall yellowish-brown and coiled round the oogonium.

Hab. on stems of *Capsicum annuum* affected by "cancrena pedale" in southern and northern Italy.]

PHYTOPHTHORA IMPERFECTA Sarejanni

PHYTOPHTHORA IMPERFECTA var. CITROPHTHORA (R. E. Smith & E. H. Smith) Sarejanni

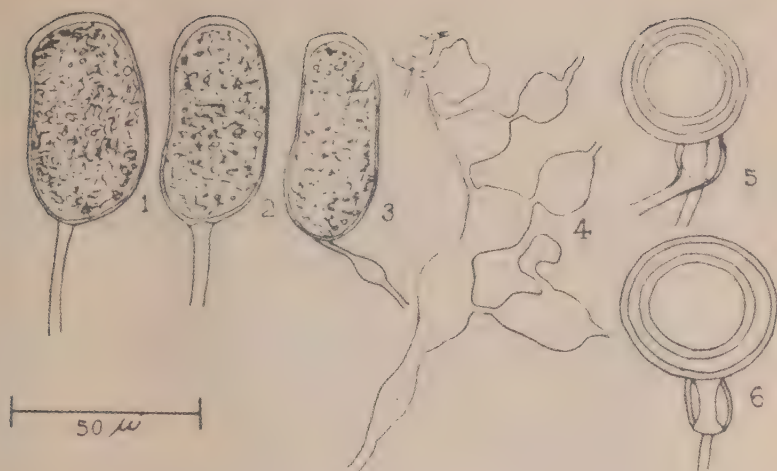
PHYTOPHTHORA IMPERFECTA var. NICOTIANAE (van Breda de Haan) Sarejanni in *Ann. Inst. phytopath. Benaki*, 2, 1, pp. 45-46, 1936 [? 1937].
Nomina nuda.

..... peut-on laisser en suspens, et sous le nom trop général de *Phytophthora* sp., un champignon dont nous avons une connaissance assez approfondie de sa biologie, et qui suggère tous les jours de nouvelles études? Pour parer à cette difficulté et pour éviter les problèmes que nous posent d'autres *Phytophthora*, dont nous ne connaissons pas au moins provisoirement les oeufs, nous proposons la création d'une nouvelle espèce *Phytophthora imperfecta* n. sp., qui sera caractérisée par l'absence d'oeufs, ou plutôt par notre ignorance de ses oeufs. Il ne s'agirait pas, évidemment d'une vraie espèce, mais d'une entité mycologique provisoire, à qui on confierait un rôle analogue à ceux qu'ont nos différentes divisions de Fungi Imperfecti. Un champignon donné pourrait rester sous cette dénomination et être plus tard transféré au groupe de *P. cactorum* ou de *P. palmivora* sans inconvénient. L'adoption d'ailleurs de cette fausse espèce permettra d'adjoindre à ce nom spécifique sous la rubrique de variété ou sous-variété plusieurs connaissances codifiées qui appartiennent à différentes souches. Ainsi nous pourrions dire *P. imperfecta* var. *citrophthora* pour le champignon qui provoque la gommose des citruses, ou *P. imperfecta* var. *nicotianae* pour les souches des champignons du 'black shank', dont on ne connaît pas encore des oeufs.

[..... must we leave in doubt, and under the name so general as *Phytophthora* sp., a fungus of which we have an adequately deep knowledge of its biology, and which all the time suggests fresh studies? To get over this difficulty and evade problems posed to us by other species of *Phytophthora*, the oospores of which we do not know, at least provisionally, we propose the erection of a new species *Phytophthora imperfecta* n. sp., which will be characterised by the lack of oospores, or rather our ignorance of them. It would not obviously act as a true species, but a provisional mycological entity, on which one would confer a role analogous to those which we have in the different groups of the Fungi Imperfecti. A given fungus may be left under this designation and be later transferred to the species *P. cactorum* or *P. palmivora* without inconvenience. The adoption elsewhere of this false species will allow the attachment to this specific name under the rubric of variety or sub-variety systematized knowledge which relates to different strains. Thus will we be able to say *Phytophthora imperfecta* var. *citrophthora* for the fungus causing gummosis of citrus, or *Phytophthora imperfecta* var. *nicotianae* for the strains of the black shank fungus of which we do not know the oospores.]

BOTRYTIS INFESTANS Montagne in L'Institut (J. univ. Sci. Soc. sav. Sect. I), 1845, p. 313, 30th August 1845; reprinted in *Bull. Soc. philom. Paris*, pp. 98-100, 1845.

On s'accorde généralement à croire que cette affection est occasionnée par la présence d'un champignon de la famille Mucédinées, et, ce qui est bien remarquable, par une Mucédinée appartenant à ce même genre *Botrytis* dont fait également partie l'espèce qui sévit si cruellement parfois sur les Vers à soie. Ce *Botrytis*, qu'en raison de ses effets nous proposons de nommer *Botrytis*



Phytophthora himalavensis

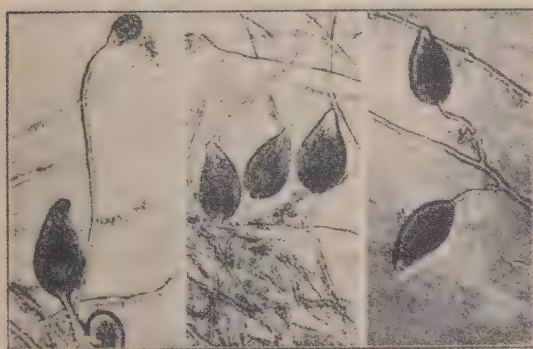


FIGURE 1

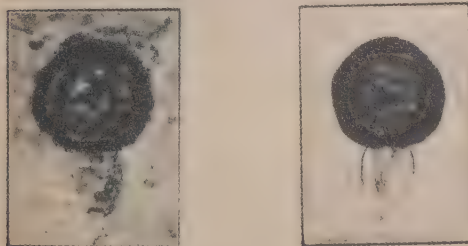


FIGURE 2

Phytophthora hydrophila — fig. 1, $\times 160$; fig. 2, $\times 550$

infestans, attaque surtout les dessous des feuilles de la Solanée, qu'il recouvre entièrement comme d'une poussière blanche, . . .

Caespitibus laxis, effusis, albis, apice parce ramosis, ramis passim nodosis erecto-patentibus, sporis lateralibus terminalibusque solitariis, ovoideis ellipticisve, magnis, subapiculatis, concoloribus, nucleo granuloso.

[It is generally agreed to believe that this affection is caused by the presence of a fungus of the family Mucedineae, and, what is very remarkable, by a Mucedineae belonging to the same genus, Botrytis, to which also belongs the species that is sometimes cruelly severe on silkworms. This Botrytis, which because of its effects we propose to name Botrytis infestans, attacks especially the lower surfaces of the leaves of Solanum, which it covers completely as with a white dust, ...

Tufts lax, spread out, white, apex sparingly branched, branches here and there nodose, standing erect, spores lateral and terminal, solitary, ovoid or elliptical, large, subapiculate, concolorous, with granular contents.]

Further description apud Berkeley in J. R. hort. Soc. [then J. hort. Soc. Lond.], 1, p. 30, figs., 12, 14-19, 1846.

The following characters were transmitted to me by him [Montagne], together with copious sketches of this and other species which I have availed myself of in the figures. It was his intention to have published them himself, but at my request he gave up the intention, placing his material in my hands — a mark of kindness and liberality which demands public thanks, though only one amongst a multitude of similar instances.

The species is characterised as follows:-

Botrytis infestans, Mont. caespitibus laxis erectis albis apice plus minus ramosis; ramis passim nodosis erecto-patentibus, sporis lateralibus terminalibusque solitariis ovoideo-ellipticis pro ratione magnis concoloribus subapiculatis, nucleo granuloso. Mont. L'Institut, 1845, p. 313. — Botrytis fallax, Desm. MSS. — Botrytis devastatrix, Lib. — Morren, in Ann. de la Soc. de l'Ag., &c., de Gand, 1845, p. 287, cum Icone.

Hab. in paginâ inferiori foliorum Solani tuberosi necnon in tuberculis ipsis aggeratis.

Maculae albae farinosae parum densae aut confertae in parte folii inferiori observantur. Flocci steriles inter meatus intercellulares repentes, fertiles, qui e stomatibus emittuntur, inter pilos folii sparsi erecti subtus simplices $\frac{1}{2}$ lineam in tuberculis attingentes superantesque, saepius vero praesertim ad folia $\frac{2}{5}$ lineam metientes, apice ramosi septati albi, Rami 2 ad 6 erecto-patentes acuti virgati passim elliptico-subincrassati hinc nodosi. Sporae pro ratione plantae maximae primo globulosae ovoideae tandem ellipticae et tum seminibus Peponis non absimiles, altero fine ad speciem mammillatae subapiculatae, altero vero brevissime pedicellatae, pellucidae floccis concolores, nempe niveae, intus sporulis endosporio inclusis farctae. Long. spor. $\frac{3}{100}$ millim., crassit $\frac{2}{100}$ millim.

[Botrytis infestans, Mont. tufts lax, white, erect, apices more or less branched; branches here and there nodose, standing erect, spores lateral and terminal, solitary, ovoid-elliptical for a large part, concolorous, subapiculate, contents granular.

Hab. in the lower leaflets of the leaves of Solanum tuberosum and also in the tubers of the same hill.

Spots white, mealy, not very dense or close, to be observed on some of the lower leaves. Sterile hyphae running in the intercellular space, the fertile, which emerge from the stomata, between the hairs of the leaf, sparse, erect



Botrytis infestans — figs. 12, 14, no magnification given; 15, 19, $\times 780$



Phytophthora infestans — fig. 3, $\times 200$; fig. 4, $\times 390$

below, simple $\frac{1}{2}$ line in affected and grown-over tubers, often in fact, particularly in the leaves, measuring $\frac{2}{3}$ line, apices branched, septate, white. Branches 2 to 6, standing erect, branchlets acute, here and there with elliptic swellings, hence nodose. Spores mostly on the largest branches, at first globose ovoid, at length elliptical and then not unlike the seeds of Pepo [Cucurbita], one end of a mammillate shape, subapiculate, the other very shortly pedicellate, transparent, the same colour as the hyphae, certainly snow-white, the interior filled with small spores confined in an endospore. Length of spore $\frac{3}{100}$ millim., thickness $\frac{2}{100}$ millim.]

[Berkeley's paper containing this diagnosis was reprinted as Phytopath. Classic 8, by the American Phytopathological Society in 1948.]

PERONOSPORA INFESTANS (Montagne) Caspary, Ms 1852
Klotzsch Herbar. mycol. No. 1879, 1854.

PHYTOPHTHORA INFESTANS (Montagne) de Bary in J.R. agric. Soc., 12, Ser. 2, 1, p. 240, figs. 3-4, 1876.

≡ Botrytis infestans Montagne

≡ Peronospora infestans (Montagne) Caspary [q. v.]

[Characters as for the genus, q. v. above]. . . . the potato fungus, Peronospora infestans, Mont., is the only one which has this peculiarity. It may therefore be distinguished as Phytophthora infestans.

PHYTOPHTHORA INFESTANS var. PHASEOLI (Thaxter) Leonian in Amer. J. Bot., 12, 7, pp. 484, 493, July 1925.

The resemblance between P. infestans and P. phaseoli is too striking to be overlooked. There is no doubt in the writer's mind that these two cannot be placed in different species, consequently P. phaseoli is made a variety of P. infestans.

P. infestans forms no oogonia in oatmeal agar and no sporangia in potassium carbonate or in arginine; var. phaseoli produces both oogonia and sporangia.

PHYTOPHTHORA INFLATA Caroselli & Tucker in Phytopathology, 39, 6, p. 485, fig. 3, June 1949.

Hyphis primo continuis, maturitate septatis, vulgo levibus. Sporangii in agare cultis raris, sed copiosis in mattis mycelialibus lavatis e solutione nutrita septem dierum ad aquam distillatum et sterilem translatis et septum dies incubatis; nascentibus in sporangiophoris non a mycelio distinctis; vulgo limoniformibus, elongatis, papillatis, $20-67 \times 15-32 \mu$, fere circa $38 \times 23 \mu$. Zoosporis in sporangia formatis, biflagellatis, motis concavo-convexis, quietis globosis, in diametrum $10-12 \mu$, Chlamydosporis ignotis.

Oogoniis spheroidalibus, hyalinis, levibus, tenui-membraneis, cauli angusto, $30-42.7 \mu$, fere 34μ . Oosporibus singulis, levibus spheroidalibus hyalinis aut subfuscis, $26-39.3 \mu$, fere 31.3μ . Membrana crassa ($3-4 \mu$).

Antheridiis paragynosis, inflatis, vulgo multis modis controtis, non constanter lobatis aut ramosis.

Habitat in cortice vivo Ulmi americanae et U. fulvae in regione U.S.A. vergente in septentriones et orientem solem.

Hyphae continuous when young, becoming septate with age, usually smooth. Sporangia rare on agar media but developing abundantly on washed mycelial mats transferred from 7-day pea broth cultures to sterile distilled water and incubated 7 days; sporangia borne terminally on sporangiophores not differentiated from vegetative hyphae, limoniform to elongate, papilla broad, rounded and nearly filled by contents of sporangium; hyaline dehiscence plug lenticular; sporangia variable in shape and size, $20-67 \times 15-32 \mu$, averaging about $38 \times 23 \mu$. Zoospores fully differentiated within the sporangium, biflagellate, reni-

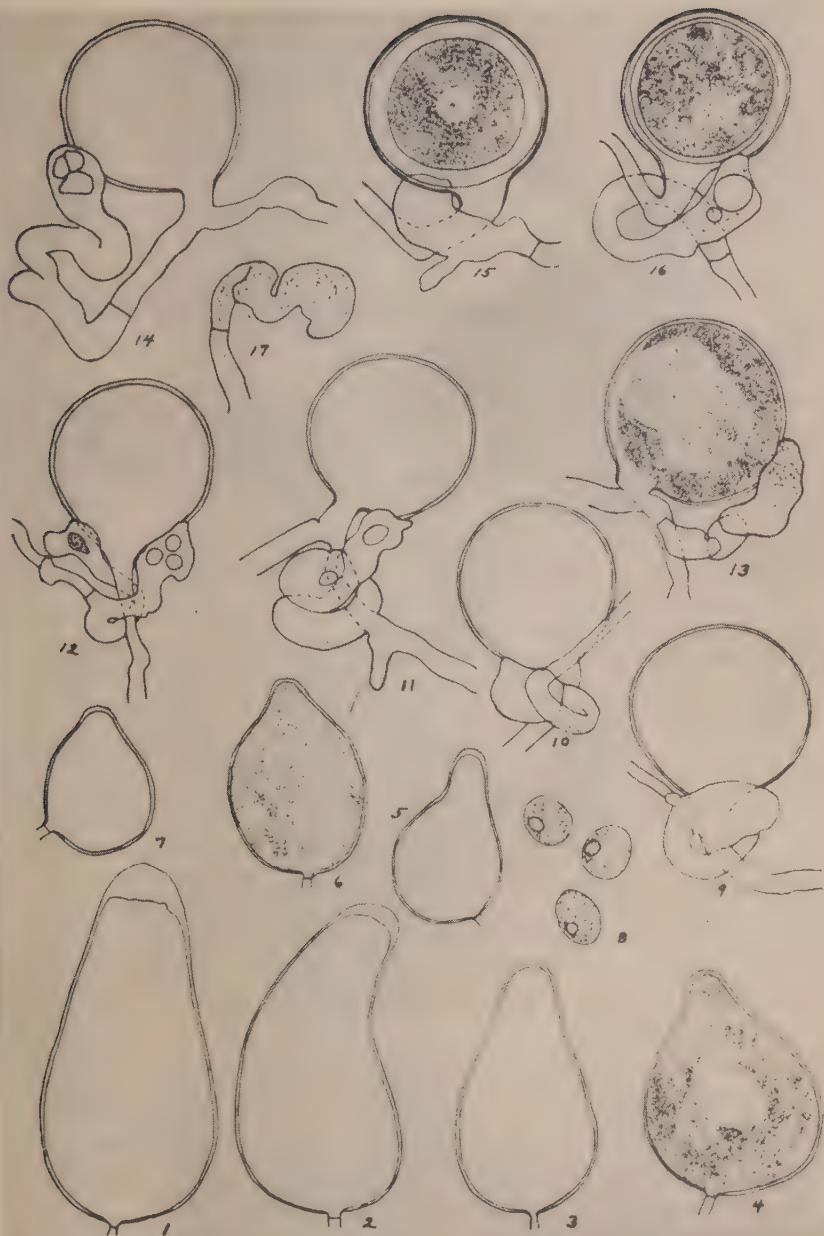


FIGURE 3

Phytophthora inflata — fig. 3, $\times 1,000$

form in motile stage, spheroidal in quiescent stage, 10-12 μ in diameter. Chlamydospores not observed, but thin-walled hyaline intercalary swellings occasionally develop.

Oogonia abundant in oatmeal cultures, thin-walled, hyaline, spheroidal, stalk narrow, not infundibuliform, 30-42.7 μ , averaging 34 μ . Oospores single, spheroidal, smooth, nearly filling oogonium, hyaline to straw colour, wall fairly thick (3-4 μ), contents densely granular, usually with a single large reserve globule and frequently 1 to 4 smaller globules, 26-39.3 μ , averaging 31.3 μ .

Antheridia paragynous, point of contact with oogonium usually near oogonial stalk, inflated, usually variously contorted, often twining or twisted about oogonial stalk, often irregularly lobed or branched, arising from a separate hypha or, occasionally, from oogonial hyphae, more numerous in culture than oogonia but seldom more than one in contact with an oogonium, up to 50 μ long and 15 μ in diameter.

Habitat — living cortical tissues of *Ulmus americana* L. and *U. fulva* Michx., northeastern United States of America.

PHYTOPHTHORA JATROPHAE Jensen

[The citation usually quoted for this name is H. Jensen in *Jaarboek van het Dept Landbouw in Nederland Indie* 1910. I have searched this volume but cannot find the name, though Jensen describes an unnamed species of *Phytophthora* on *Jatropha*. Cultures were issued by Jensen about this time and the name is included in the culture list of the Centraalbureau voor Schimmelcultures, Baarn, in 1912. A description cannot be traced.]

PHYTOPHTHORA LATERALIS Tucker & Milbrath in *Mycologia*, 34, 1, p. 97, figs. 1-14, January-February 1942.

Hyphis primo continuis, maturitate septatis, vulgo levibus, nonnumquam tuberosis. Sporangii in agar cultis nullis, sed copiosis in mattis mycelialibus lavatis e solutione nutritia septem dierum 20°C. ad aquam distillatum et sterilem translatis et septem dies incubatis 20°C, sympodialiter nascentibus in sporangiophoris non a mycelio distinctis; vulgo ovatis, obovatis, obpyriformibus; nonnumquam elongatis aut hyalinis aut flavidis, nonpapillatis, cum obturamento apicali et refringenti et pergracili, 26-60 $\times$ 12-20 μ , fere circa 36 $\times$ 15 μ . Zoosporis in sporangio formatis, biciliatis, motis concavo-convexis, quietis globosis, in diametrum 10-12 μ . Chlamydosporis copiosis in agar cultis et in liquore, vulgo subglobosis globosis, nonnumquam ovatis-irregularibus, cum protoplasmate granulis dense repleto, flavidis-subfuscis, cum pariete vulgo tenui nonnumquam crassa (6-7 μ); terminalibus aut intercalaribus a latere hyphae myceli nascentibus; maturitate saepe evidenter sessilibus; in diametrum 20-77 μ fere circa 40 μ ; tubo germinantibus; oogonis, antheridiis, oosporis ignotis.

Hab. in cortice vivo *Chaemaecyparis Lawsonianae* Parl., Oregon, U.S.A.

Hyphae continuous when young, becoming septate with age, usually smooth, but sometimes gnarled to tuberosous. Sporangia none on agar media but developing fairly abundantly on washed mycelial mats transferred from 7-day pea broth cultures (20°C) to sterile distilled water and incubated 7 days at 20°C; sporangia borne sympodially on sporangiophores resembling vegetative hyphae, mostly ovate, obovate, or obpyriform, occasionally elongate, hyaline to lemon yellow, nonpapillate, with apical refringent plug very thin and often indistinguishable, 26-60 $\times$ 12-20 μ , averaging about 36 $\times$ 15 μ . Zoospores fully differentiated within the sporangium, biciliate, reniform in motile stage, spherical in non-motile stage, 10-12 μ in diameter. Chlamydospores abundant in agar cultures and liquid media usually subspherical to spherical, occasionally ovate to irregular, contents densely and often coarsely granular, lemon yellow to light brown; wall usually thin, sometimes thick (6-7 μ); terminal or intercalary, the latter developing as lateral swellings of the hyphae, often appearing sessile at maturity,

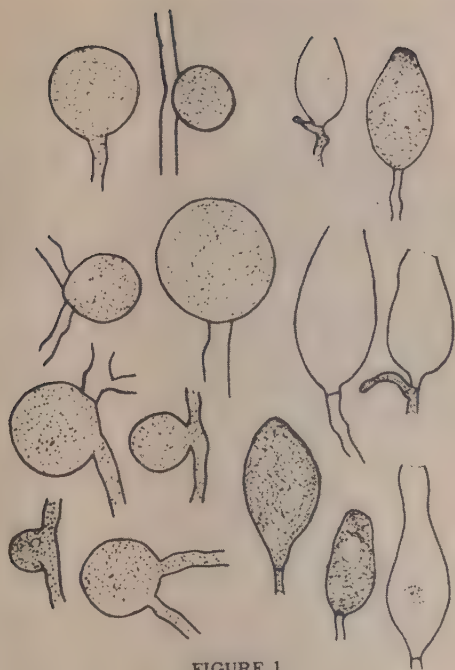
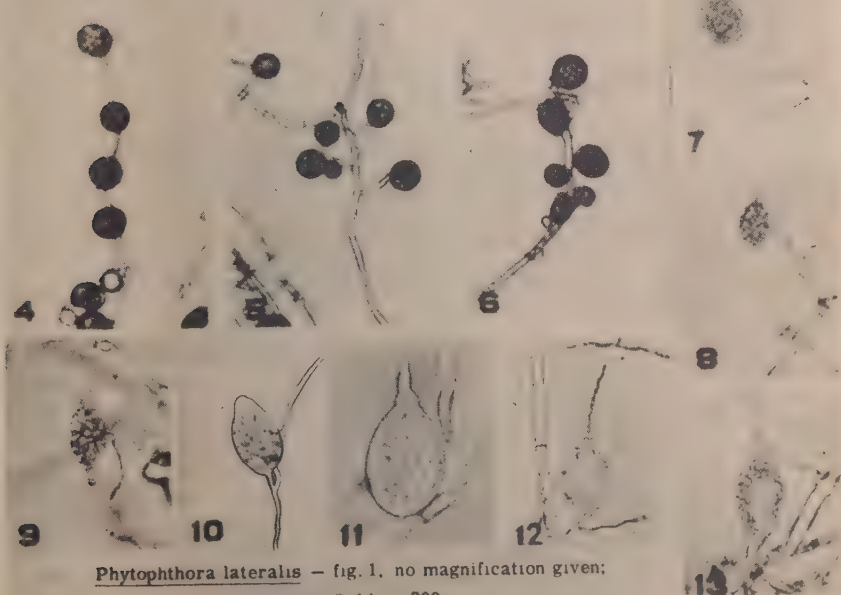
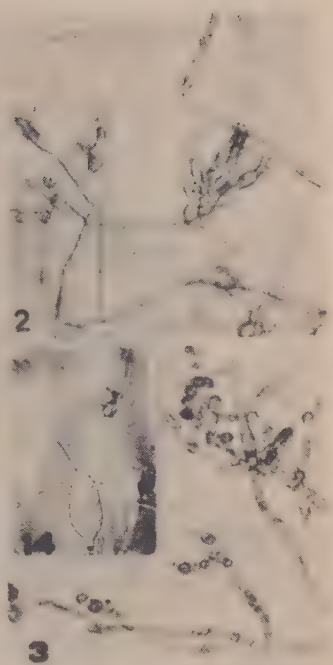


FIGURE 1

*Phytophthora lateralis* — fig. 1, no magnification given;2-6, $\times 100$; 7-14, $\times 200$

20-77 μ in diameter, averaging about 40 μ ; germinating by germ tubes. Oogonia, antheridia and oospores unknown.

Type isolated from Chamaecyparis Lawsoniana Parl. in Oregon, U.S.A.

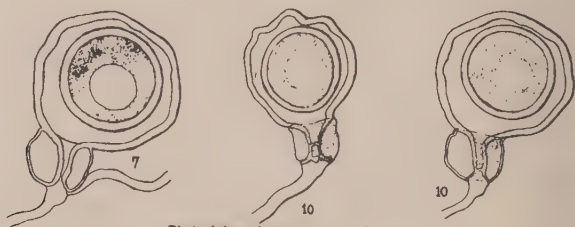
PHYTOPHTHORA LEERSIAE Sawada in Trans. nat. Hist. Soc. Formosa, 31, 213, p. 267, June 1941. [Japanese.]

Mycelium aseptate, with pseudo-septa in old hyphae 6-8 μ in diam.; oogonium globose, globose-depressed, ovate, or rarely narrowly oblong, 45-68 $\times$ 28-60 μ , averaging 53.9 $\times$ 48.9 μ (average of 9), with straw coloured walls, 3.5-4 μ thick. The ratio between the diameters of oogonium and oospore is 1:23. Antheridia amphigynous, globoid, 20-28 $\times$ 20-28 μ , averaging 23.9 $\times$ 23.5 μ . No conidia found.

Parasitic on the leaves of Leersia hexandra Sw. at Taipeh, 27. 4. 1918.

Differs from P. megasperma in the larger oogonia, smaller oospores, usually amphigynous antheridia, and the fact that it is parasitic on a monocotyledonous plant.

[From a translation by Dr. C. T. Wei. No Latin diagnosis. Figures in Rep. Govt. agric. res. Inst., Taiwan (formerly Formosa), 83, pl. I fig. 10, 1942; 85, pl. I fig. 7, 1943.]



Phytophthora leersiae — figs. 7, 10, $\times$ 405

PHYTOPHTHORA LEPIRONIAE Sawada in Bull. Formosa agric. Exp. Sta. 131, p. 10, pl. 2 (figs. 1-14), January 1919. [Japanese.]; Bull. Formosan Agric. 146, p. 8, 1919. [English.]

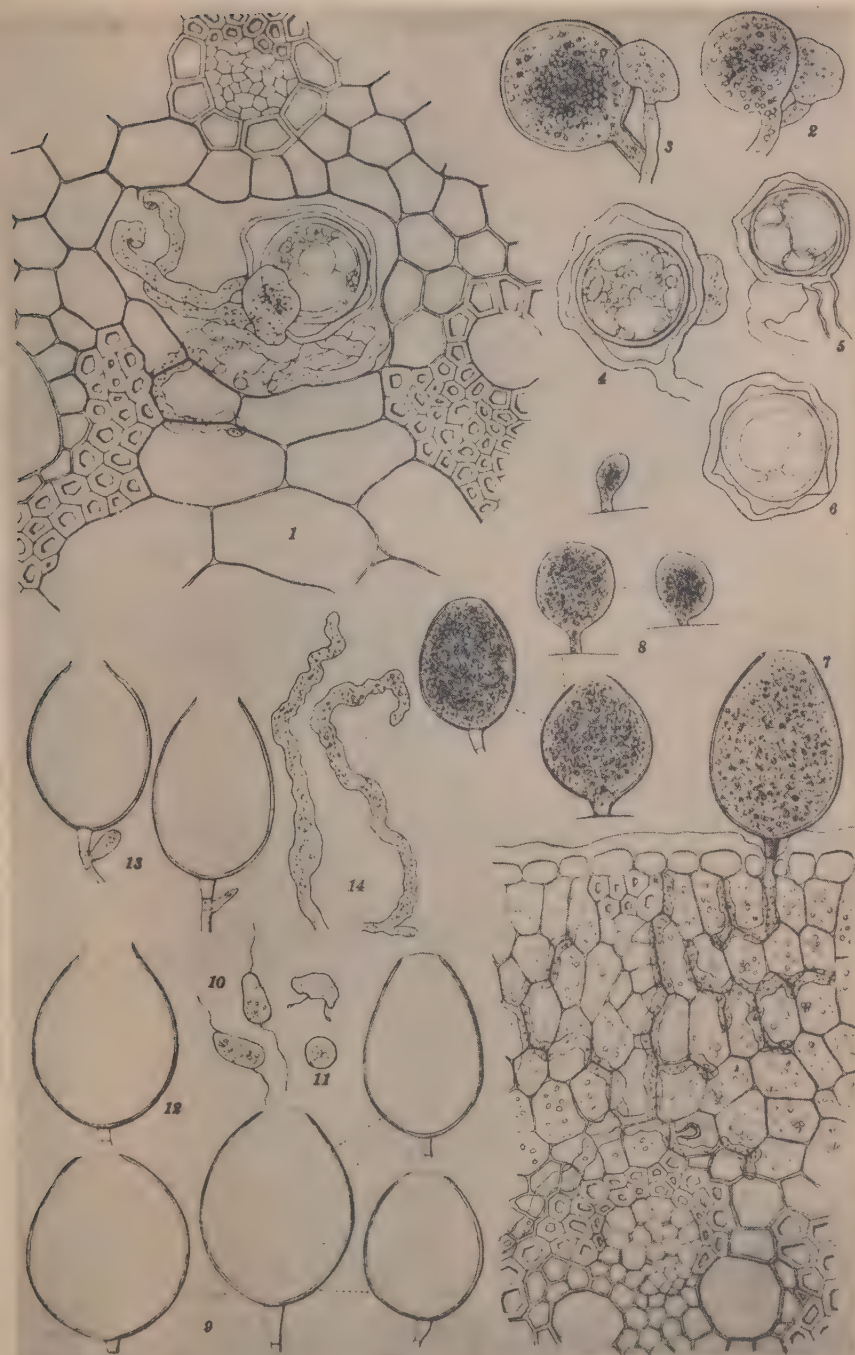
≡ Kawakamia lepironiae (Sawada) Sawada in Agric. Mag. Formosa, 38, 5, p. 351, 1942.

≡ Nozemias lepironiae (Sawada) Sawada in Spec. Bull. Govt. Res. Inst. Taihoku 19, p. 88, December 1919.

Maculis calamicolis, fusco-brunneis, elongatis; hyphis intercellularibus, 3-8 μ latis, haustriis obovoideis, ca. 7 $\times$ 8 μ instructis; conidiophoris e stomatibus erumpentibus, brevissimis, usque ad 13 μ longis, simulate hyphae simulibus, rarissime ramosis; sporangiis ovoideis vel ovoideo-globosis, apice rotundatis, misere papillatis, basi brevissime pedicellatis, 40-64 $\times$ 36-52 μ , per zoosporas germinatibus; oogoniis sphaericis, dein plus minusque angulatis, 40-52 $\times$ 40-48 μ , membrana 4 μ crassa; antheridiis obovoideis, diclinis, paragenis, 22-24 $\times$ 14-16 μ ; oosporis sphaericis, flavo-brunneis, 30-38 μ diam., episporio levi, 3-4 μ crasso tectis.

Hab. in calamis Lepironiae mucronatae Rich.

[Spots on stems dark brown, elongated; intercellular hyphae 3-8 μ broad, furnished with obovoid haustoria ca. 7 $\times$ 8 μ ; conidiophores emerging from the stomata, very short, up to 13 μ long, resembling blunt hyphae, very rarely



Phytophthora lepironeae — figs. 1-14, Zeiss 4 × DD [slightly reduced from original.]

branched; sporangia ovoid or spherical-ovoid, rounded at the apex, scarcely papillate, base shortly pedicellate, $40-64 \times 36-52 \mu$, germinating by zoospores; oogonia spherical, then more or less angular, $40-52 \times 40-48 \mu$, wall 4μ thick; antheridia, obovoid, declinuous, paragynous $22-24 \times 14-16 \mu$, oospores spherical, yellow-brown, $30-38 \mu$ in diameter, epispore smooth; wall $3-4 \mu$ thick.

Hab. on stems of Lepironia mucronata.

Latin diagnosis from S. Ito & Y. Tokunaga in Trans. Sapporo nat. Hist. Soc., 14, 1, p. 14, 1935.]

PHYTOPHTHORA LYCOPERSICI Sawada in Agric. Mag. Formosa, 38, 4, p. 253, 1942. [Japanese.]

Aerial mycelium on tomato fruits $3-6 \mu$ wide; internal mycelium $3-10 \mu$.

Conidia terminal on hyphae arising from below the preceding one, or intercalary, broadly ovate or ovoid, with one prominent, rarely 2-3 irregular papillae. On aerial mycelium in water $14-71 \times 11-47 \mu$, average (492) $37.18 \times 27.65 \mu$ with a mode at $38 \times 28 \mu$. On cooked unpolished rice in st. d. water $19-61 \times 13-44 \mu$ average (300) $35.98 \times 25.95 \mu$, mode $32 \times 24 \mu$, l/d ratio 1:386. Papilla $3-5.5 \mu$ high, $5-8 \mu$ wide.

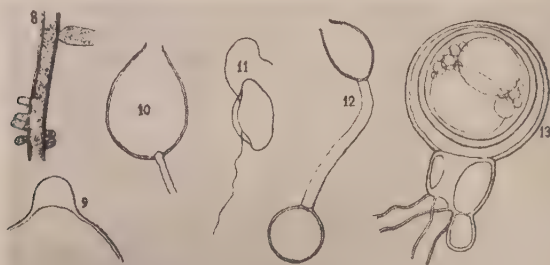
Zoospores bivacuolate $12-13 \times 7-8.5 \mu$; at rest $8-10 \mu$, giving repeated emergence or germ tubes $2-3 \mu$ diam.

Chlamydospores terminal or intercalary on aerial or internal mycelium, globose, hyaline to yellowish brown, $13-45$ ($23.4-29.4$) μ .

Oospores easily formed on various media. Oogonia globose, $17-35$ ($26.3-32.5$) μ , mode varying according to the medium from 28 to 33μ ; oospores hyaline to brown with walls $1.5-1.7 \mu$ thick, $15-34$ ($22.3-26.9$) μ , mode $22-27 \mu$, Antheridia amphigynous, usually $8-16 \times 11-15 \mu$, average $12 \times 12.4 \mu$, rarely paragynous on Cyperus decoction agar.

On Lycopersicon esculentum parasitic on fruits Taipeh, Formosa, 10. 6. 1922.

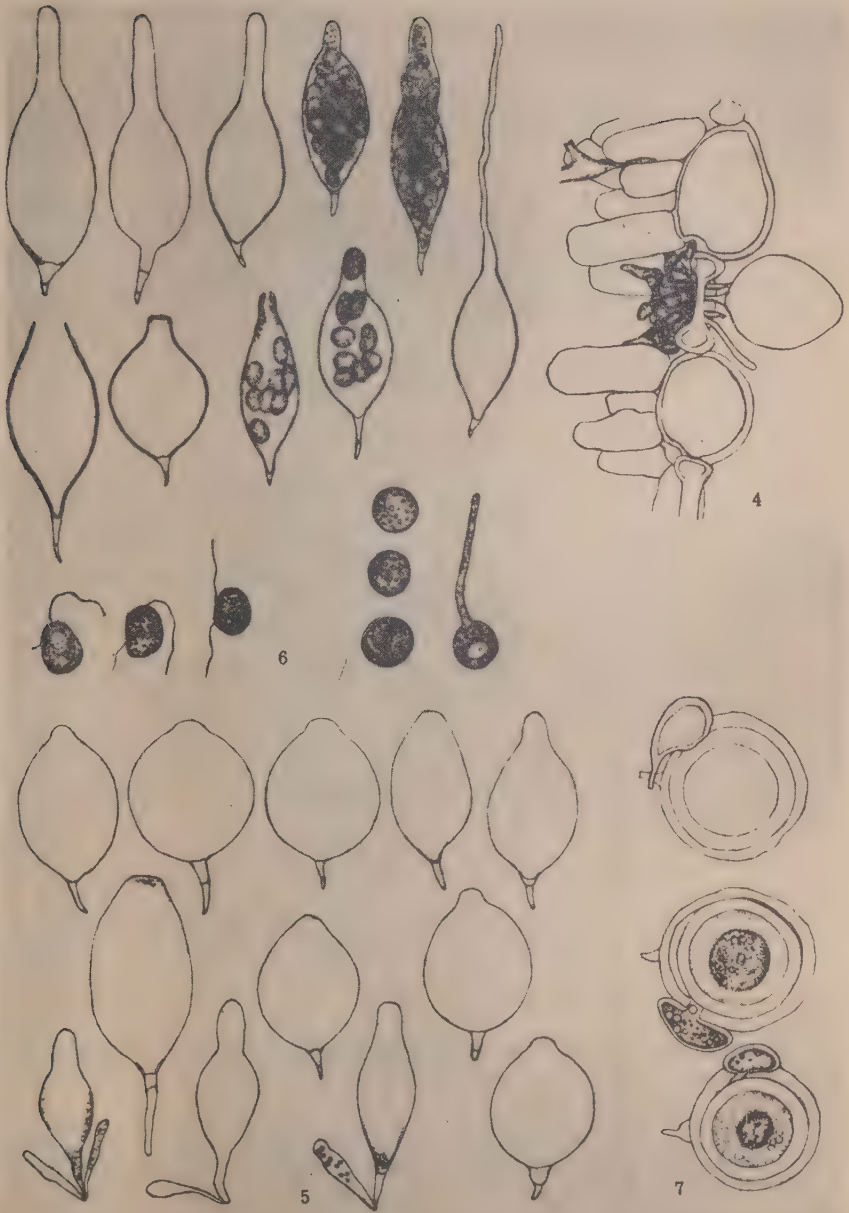
[From a translation by Dr. C. T. Wei of a reprint of the original in Rep. Gov. agric. res. Inst., Formosa, 85, 1943. Figures in the same publication pl. I figs. 8-13. No Latin diagnosis.]



Phytophthora lycopersici — (figs. 8, 10, $\times 405$; 9, 11-13, $\times 940$)

SCLEROSPORA MACROSPORA Saccardo in Hedwigia, 29, 3, p. 155, May-June 1890.

Status conidiophorus ignotus. — Oogoniis crebe parallele seriatis, tectis epidermidemque foliorum late rugoso-punctulatam et infuscatam reddentibus; oosporis sphaericis, magnis, $60-65 \mu$ d., episporio levi, bistratoso, valido, hyalino-fuscello, intus crasse pluri-nucleatis, hyalinis, ex hyphis angustis, ramulosis guttulatis hyalinis orientibus.



Phytophthora macrospora — no magnification given

Hab. in foliis inferioribus adhuc vivis *Alopecuri*, socia *Puccinia rubigine-vera* Caromby. Ab affini *Scl. graminicola* differt oosporis multo majoribus. Quamquam conidia adhuc ignota, ad gen. *Sclerosporam* spectare videtur. Antheridia subinde oosporis adhuc haerentia observavi.

[Conidial state unknown. Oogonia close together in parallel series, the leaf coat and epidermis widely rugosely spotted and rendered darker; oospores spherical, large, 60-65 μ in diameter, episporium smooth, light brown, stout hyaline-fuscos, thick within, multinucleate, hyaline, from a narrow, branching hypha with hyaline globules.

Habitat in the lower, still living leaves of *Alopecurus*, in company with *Puccinia rubigine-vera* Caromby. Close to *Scl. graminicola* but differing in the much larger oospores. Although the conidia are as yet unknown it will be seen to lie in the genus *Sclerospora*. Antheridia often observed still adhering to the oospores.]

PHYTOPHTHORA MACROSPORA (Saccardo) Ito & Tanaka in *Ann. phytopath. Soc. Japan*, 10, 2-3, p. 135, figs. 4-7, December 1940.

≡ *Sclerospora macrospora* Saccardo [q. v.]

The conidia are pear-shaped, obovate, or ellipsoidal, hyaline to slightly purplish, granulate, slightly blunted to papillate, 57.5-97.5 $\times$ 30-65 μ (natural material) or 65-112.5 $\times$ 32.5-55 μ , averaging 87.37 $\times$ 43.75 (in water). The conidiophores are hyaline, 7.5-27.5 μ long (average 13.83 μ) and 1.25-3.75 μ wide. Zoospores at first ovate or an irregular kidney-shape, appearing somewhat globose while swimming, spherical at rest, 12.5-16.25 $\times$ 10-12.5 μ , averaging 14.17 $\times$ 10.8 μ . They may produce zoosporangia 10-16.25 μ , averaging 12.8 μ , with germ tubes 1.6-2.5 μ wide.

Oogonia somewhat globose, light greenish to greenish brown, 55-100 $\times$ 50-95 μ , mostly 62.5-75 $\times$ 56.5-72.5 μ , averaging 69.12 $\times$ 65.13 μ , wall 2.5-7.5 μ thick, commonly 3.75-5 μ , averaging 4.26 μ . Antheridia laterally attached, hyaline to light yellow, obovate to ellipsoidal, wall slightly thickened, granulate, 22.5-41.25 $\times$ 12.5-22.5 μ , averaging 27.75-15.15 μ wall 1.75-3.75 μ thick, averaging 2.5 μ . Oospores hyaline, somewhat globose, attached closely to the wall of the oogonium, 42.5-72.5 $\times$ 42.5-70 μ , averaging 60.25 $\times$ 56.67 μ ; wall 3.75-10 μ thick, averaging 6.48 μ .

Hosts: rice, wheat, barley, oats, maize, and wild grasses.

[Ito & Tanaka say in the English resumé of this paper (p. 137) that Tasugi stated in 1930 that *S. macrospora* should be transferred to *Nozemia*, but the new combination was not made in either of the Tasugi references given.]

PHYTOPHTHORA MANOANA Sideris

This name appeared first in the 1930 List of Cultures of the Centraalbureau voor Schimmelcultures, Baarn, Holland. No published description has been found.

PHYTOPHTHORA MEADII McRae in *J. Bombay nat. Hist. Soc.*, 25, p. 760, June 1918 [diagnosis only; full account] in *Mem. Dep. Agric. India Bot.*, 9, 5, p. 254, pls. II, III, November 1918.

Mycelium ramosum ex hyphis primo continuis tandem septatis, 3-6 μ usque ad 10 μ crassis, inter et intracellularibus; sporangiophoris ramosis 10-200 μ longis sed aliquanto brevibus; sporangiis inversipyriformibus sed variis, terminalibus vel lateralibus, in fructibus 33-67 $\times$ 14-28 μ , in aqua submersis 20-44 $\times$ 16-29 μ ; zoosporis ovatis vel ellipsoideis, biciliatis, ciliis 16-26 μ longis, sporis globosis 7-10 μ ; ogoniis pyriformis, hyalinis, levibus vel rugosis, in fructibus

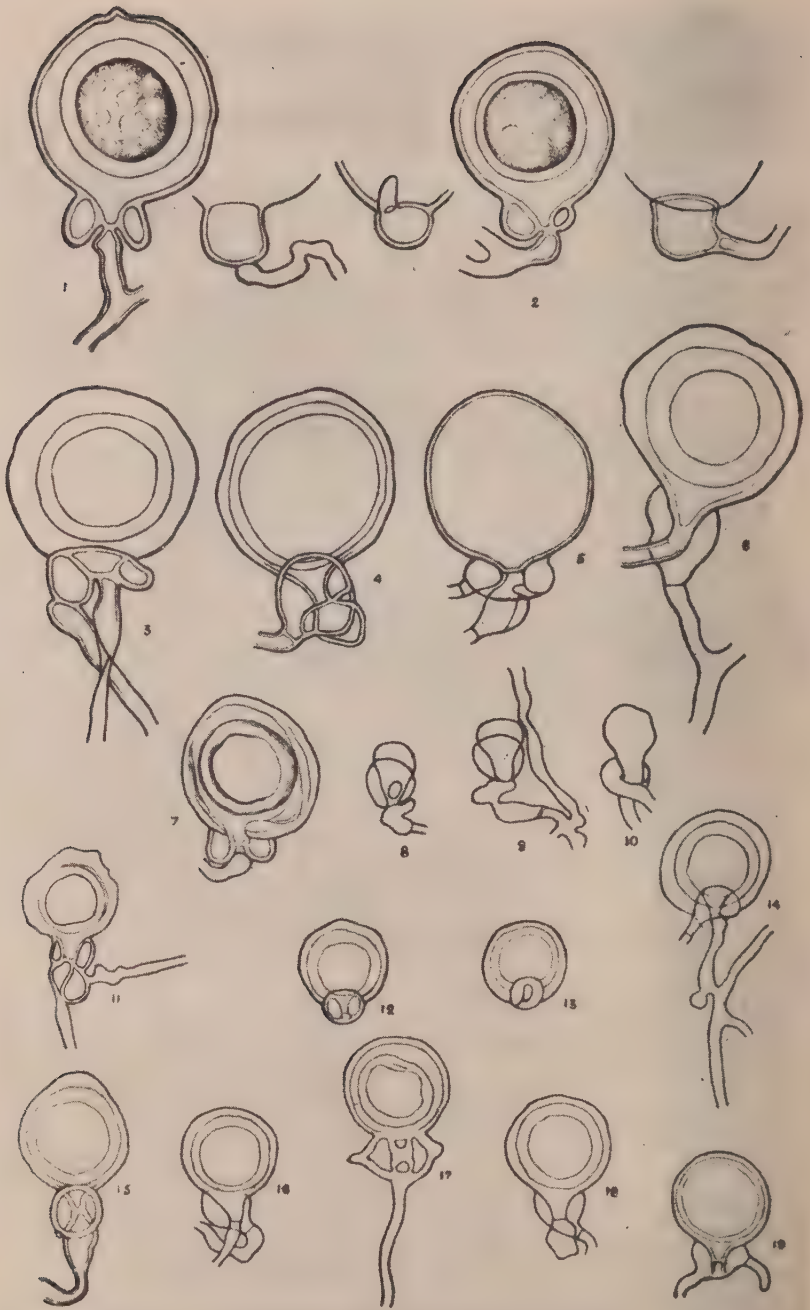


PLATE III

Phytophthora meadii

20-48 × 20-40 μ in cultibus 22-49 × 20-45 μ ; antheridiis persistentibus, hyalinis. rotundis vel ovoideis, levibus 8-16 × 10-16 μ , et oogonii basem et oogoniophori partem circumclaudentibus; oosporis sphaericis, in fructibus 18-28 × 18-26 μ in cultibus 16-32 × 15-32 μ membrana 2-4 μ crassa, mellea aut fulva, levi.

Hab. in foliis, fructibus, ramis cortice Heveae Brasiliensis
Travancore, Cochin, Malabar, Indiae orient.

[Mycelium branching from the hyphae continuous when young, septate when older, 3-6 μ or up to 10 μ thick, inter and intra-cellular; sporangiophores branched 10-200 μ long but somewhat short; sporangia inversepyriform but variable, terminal or lateral, on Hevea fruits 33-67 × 14-28 μ , in water culture 20-44 × 16-29 μ ; zoospores ovate or ellipsoid, biciliate, cilia 16-26 μ long spores globose, 7-10 μ ; oogonia pyriform, hyaline, smooth or wrinkled. in fruits 20-48 × 20-40 μ , in culture 22-49 × 20-45 μ ; antheridia persistent, hyaline, round or ovoid, smooth 8-16 × 10-16 μ , amphigynous, oospores round, in fruits 18-28 × 18-26 μ , in culture 16-32 × 15-32 μ wall 2-4 μ thick, honey-coloured or tawny, smooth.

Hab. on leaves, fruits, bark of branches of Hevea brasiliensis in
Travancore, Cochin and Malabar, India.]

PHYTOPHTHORA MEADII var. ANANAPHTHOROS Sideris

This name appeared first in the 1930 List of Cultures of the Centraalbureau voor Schimmelcultures, Baarn, Holland. No published description has been found.

PHYTOPHTHORA MEGASPERMA Drechsler in J. Wash. Acad. Sci., 21, 21, p. 525, figs. 2-5, December 19 1931.

Mycelium intercellular in tissues of host; on artificial substratum of somewhat radiating aspect, composed of freely branching hyphae from 3 to 8 μ in diameter; continuous in actively growing stage, later, on becoming evacuated, developing numerous, rather thick septa; producing aerial growth in small or moderate quantity; under aquatic conditions extramatrical growth meagre. Sporangium regularly formed terminally on a long, simple or sparingly branched, extra-matrical filament measuring mostly 50 μ to 2 mm. in length and 2 to 2.5 μ in diameter, though often expanding in the distal portion to a diameter of 3 to 5 μ ; later often coming into a lateral position through continued elongation of the supporting filament from immediately below the delimiting septum; regularly ovoid, but occasionally bearing distally a protuberance or lobe of variable size; measuring 6 to 45 μ in transverse diameter by 15 to 60 μ in length; on dehiscence opening broadly at apex without formation of an outwardly protruding papilla; after evacuation proliferous in moderate measure, both by formation of sessile or nearly sessile secondary or often tertiary sporangia within primary one and by repeated growth of the supporting filament through the orifices of the empty envelope to produce additional sporangia externally. Zoospores produced from 1 to 45 in a sporangium; reniform, longitudinally grooved, biciliated, after rounding up measuring 10 to 13 μ in diameter; individually germinating by germ-tubes usually 1 to 3 in number, or often, whether properly liberated or retained within the sporangial envelope owing to frustrated dehiscence, often giving rise to a secondary zoospore, - the repetitional development taking place either by direct discharge of contents through an evacuation tube 3.5 to 5.5 μ in diameter and 1 to 10 μ in length, or by the production of an elongated miniature sporangium mostly 6 to 10 μ in diameter and 16 to 22 μ in length on a germ sporangiophore mostly 1.5 μ in diameter and 10 to 60 μ in length.

Oogonium borne terminally on a stalk usually 5 to 15 μ in length; smooth, sub-spherical, measuring 16 to 61 μ , mostly 42 to 52 μ (average 47.4 μ) in diameter; provided with a wall 0.5 to 1.7 μ (average 1.2 μ) in thickness. Antheridium single; irregularly orbicular or prolate ellipsoidal, sometimes provided with a distal protuberance or lobe; measuring usually 10 to 18 μ in diameter by 14-20 μ in length; in some (1 to 35 out of 100) cases amphigynous, but more often paragynous, in latt

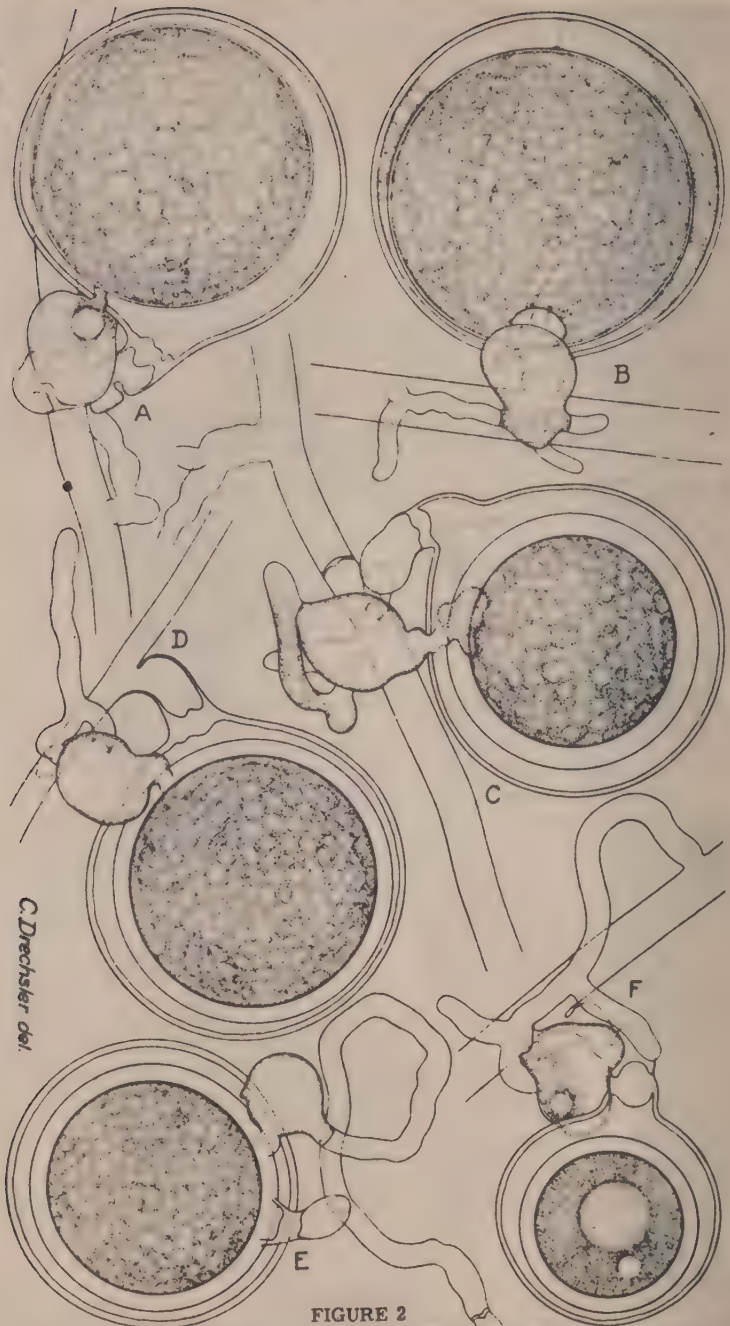


FIGURE 2

Phytophthora megasperma — figs. 2, 4, $\times 1,000$; fig. 5, $\times 500$

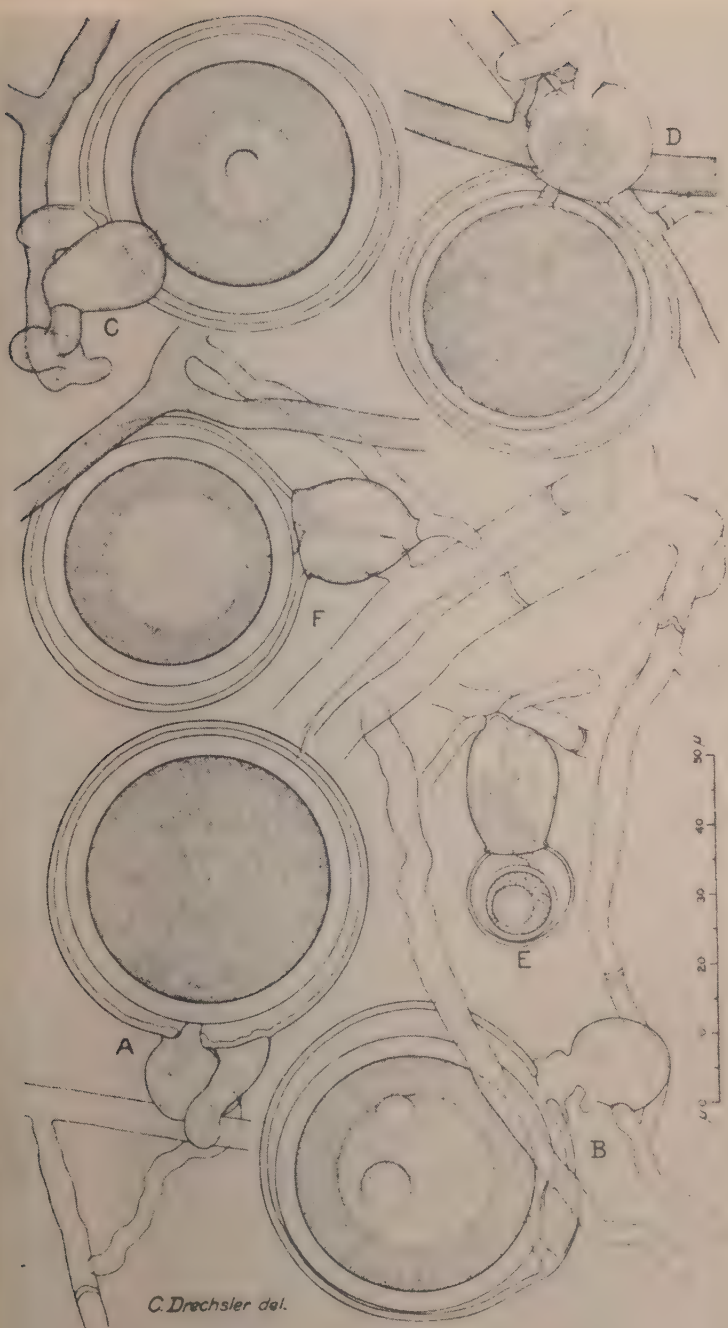


FIGURE 4
Phytophthora megasperma

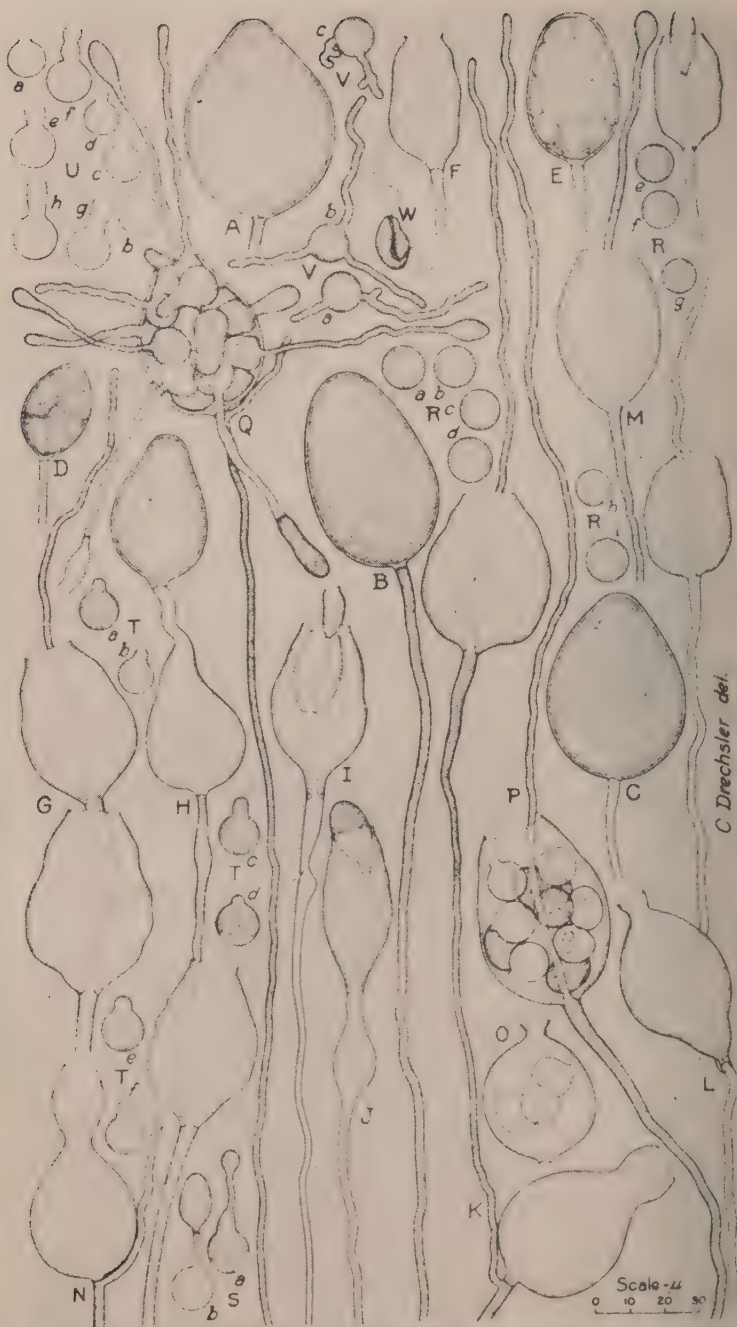
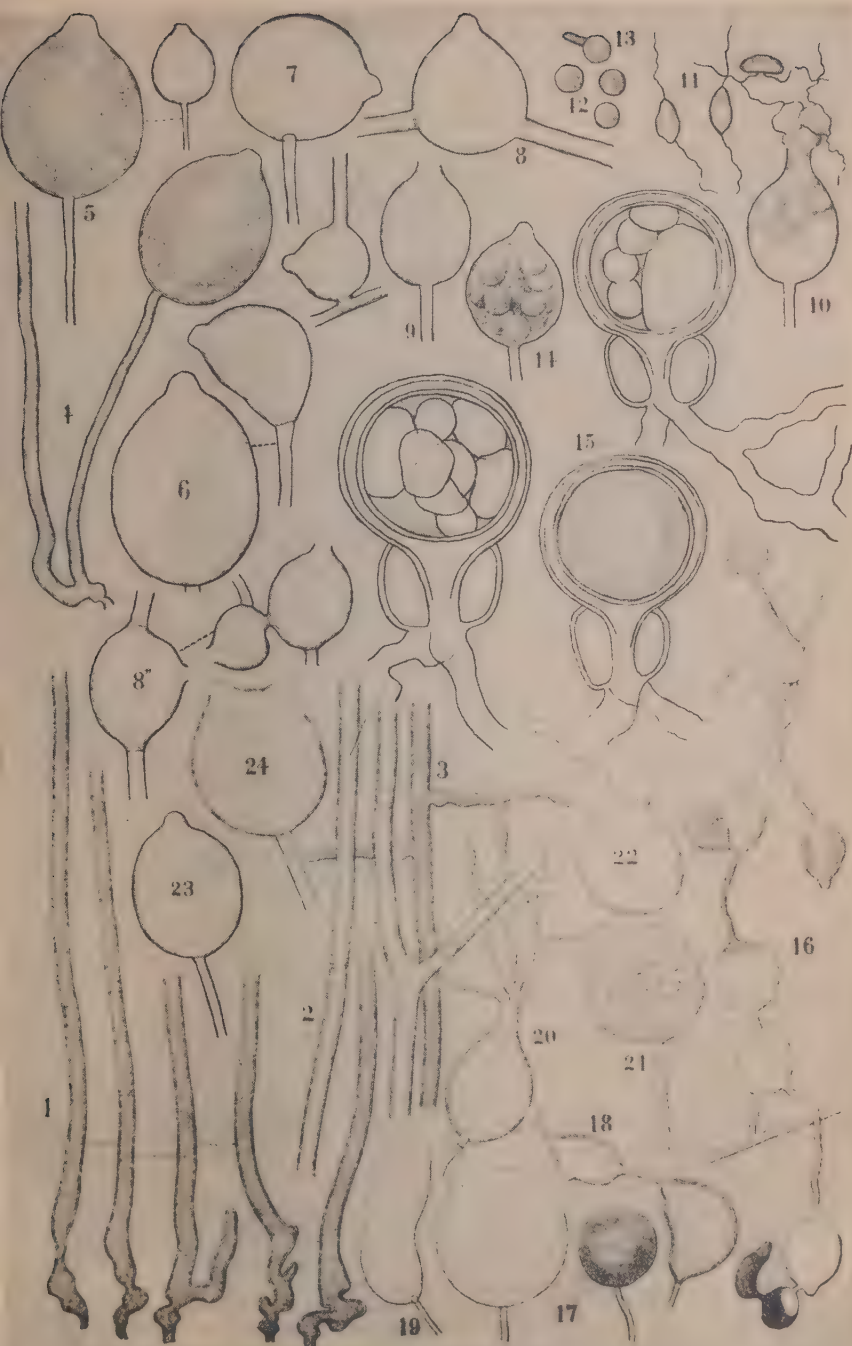


FIGURE 5
Phytophthora megasperma



Phytophthora melongenae — figs. 1-14, 16-24, Zeiss 4 × DD;
 15, Zeiss 4 × F [Slightly reduced from original.]

in latter event usually applied near base of oogonium and often in intimate contact with oogonial stalk; borne laterally or terminally or in intercalary relationship on a branch mostly 5 to 50 μ in length, the branch sometimes arising from a hypha not demonstrably connected with the oogonial hyphae, but sometimes having close mycelial connection with the oogonium, the total length of filamentous parts between the septa delimiting the sex organs occasionally not exceeding 40 μ . Oospore colourless or more often distinctly yellowish; smooth, subspherical, measuring 11 to 54 μ , mostly 37 to 47 μ (average 41.4 μ) in diameter; provided with a wall 0.8 to 4.6 μ (average 3.6 μ) in thickness, and containing a reserve globule measuring at early maturity 6.5 to 24.0 μ (average 17.6 μ) in diameter.

Causing a destructive decay of the stem and roots of Althea rosea
Cav. in Washington, D. C. and at Rosslyn, Va.

PHYTOPHTHORA MELONGENAE Sawada in Noji Shikenjô Tokubetsu Hôkoku
(Spec. Rep. agric. Exper. Sta.) Formosa 11, pp. 77-79, pl. 3, February
1915. [Japanese.]

Hyphae intercellular in the host tissue or freely penetrating the cell wall, much branched, not septate in juvenile stage, but septate when mature; aerial hyphae mostly not branching, usually attaining a considerable length, nearly uniform in diameter, the base always irregularly twisted, swelled or short-branched, and very characteristic; diam. of hyphae 4-8 μ ; haustoria none. Conidiophores hardly distinguishable from aerial hyphae, filiform, delicate, very much elongated, the shortest measuring 80 μ in length, 3-5 μ across; conidia spherical broad-oval or oval, 24-72 $\times$ 20-48 μ , average 42.4 $\times$ 33.9 μ , with apical hemispherical papilla 3-5 μ high, producing several to 40 zoospores; zoospores ovoid or ellipsoid, 10-11 $\times$ 8 μ , with 2 cilia; chlamydozoospores yellowish brown, spherical, 25-42 μ in diam.; oogonia formed in cultures on bean agar-agar medium, spherical, 18-23 $\times$ 20-24 μ , containing one oospore; oospore spherical, walls 2 μ thick, colourless to very pale yellowish-brown, diameter 17-21 μ . Antheridia not formed on the same hyphae that bear the oogonia but on the end of other hyphae, surrounding tightly the oogonial stalk and attached to the wall of oogonia at the juncture with the stalk, oblate spheroidal or nearly spherical, 10-14 $\times$ 12-16 μ .

Parasitic on the fruit of Solanum Melongena (eggplant).

Type locality; Taihoku-chô, Chônaiho-Shô, Formosa, June,
July, and September 1914.

[Translation by T. Tanaka in Mycologia, 9, p. 250, 1917.]

PHYTOPHTHORA MELONGENAE var. ANANAPHTHOROS Sideris

This name appeared first in the 1930 List of Cultures of the Centraalbureau voor Schimmelcultures, Baarn, Holland. No published description has been found.

PHYTOPHTHORA MEXICANA Hotson & Hartge in Phytopathology, 13, pp. 529-530, pls. 22-23, December 1923.

Mycelio ramoso irregulariter, hyalino, non-septato recentiore sed vetustiore multi-septato vacuatoque, interdum brevi et nodoso; conidiophoris primo unicis et sustinentibus conidium unum in apice sed tandem longo ramosoque; conidiis terminalibus sine inhibitionis auctus conidiophori, variabili magnitudine, paene in forma inversi pyri, 16-33 μ $\times$ 16-77 μ , interdum longioribus duplo quam latioribus, papillis prominentibus, plerumque formatibus zoosporangia; zoosporis ovoideis, depressis paulum in uno latere, germinantibus statim hyphis; chlamydozopsis intercalaribus sed paucis, paene sphaeriodeis 28-44 μ diam; luteis vetustioribus germinantibus statim hyphis; oosporis luteis vetustioribus, sphaeriodeis 24-37 μ diam.; episporis 4.4 μ densis; antheridiis terminalibus et lateralibus sphaeroideis aut ovoideis, circumambientibus bases oogoniorum

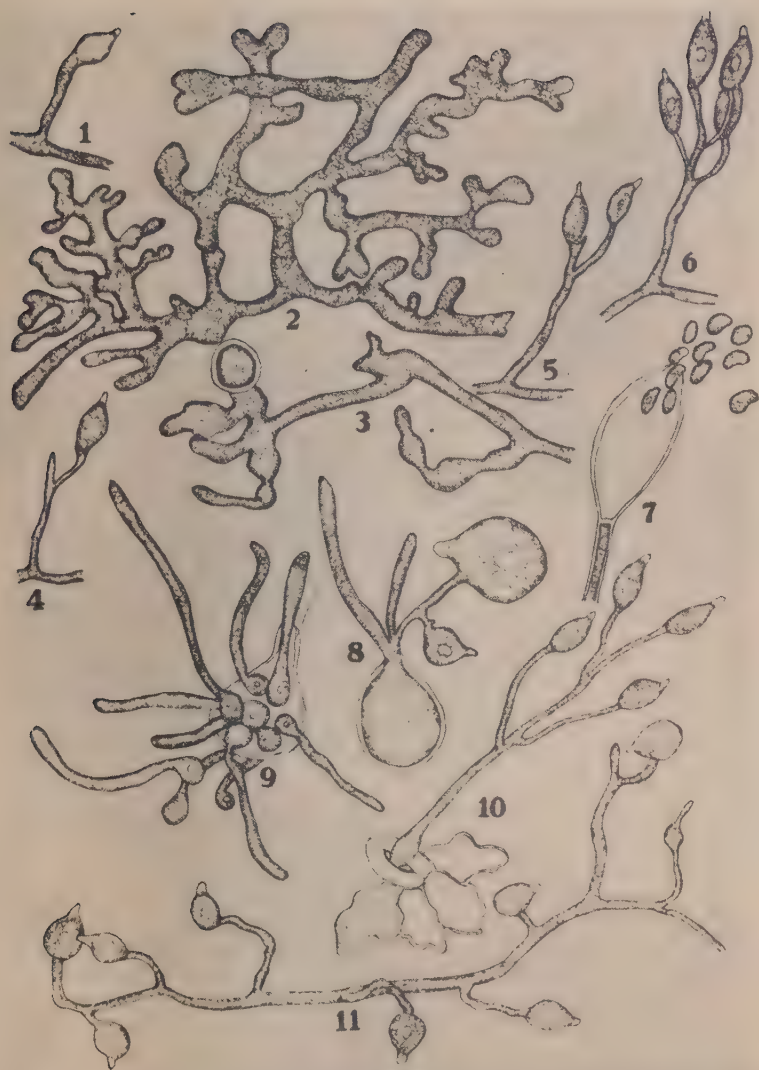


PLATE 22

Phytophthora mexicana — no magnification given

quasi penetratis ab eis sic ut in P. phaseoli Thaxter.

Hab. In fructibus Lycopersici exculenti Mill, Mexico, Amer. bor.

Mycelium irregularly branched, hyaline, non-septate, when young, often septate and empty when old, sometimes short and knobby; conidiophores at first simple and bearing a single apical conidium but eventually becoming long and much branched; conidia terminal but not inhibiting the growth of the conidiophore, varying greatly in size, more or less inversely pear-shaped, $16-33\ \mu$ by $16-77\ \mu$, sometimes measuring twice as long as wide; papillae prominent, usually forming zoosporangia; zoospores ovoid, depressed slightly on one side, germinating immediately by germ tube; chlamydospores intercalary, sparingly produced, almost spherical $28-44\ \mu$ in diameter, yellowish when old, germinating by germ tube; oospores yellowish at maturity, nearly spherical, $24-37.4\ \mu$ in diameter; epispodium $4.4\ \mu$ thick; antheridium terminal or lateral, somewhat spherical or ovoid, surrounding the base of the oogonium as if penetrated by it as in P. phaseoli Thaxter.

Hab. On the fruit Lycopersicon esculentum Mill from Mexico.

PHYTOPHTHORA MURRAYAE Sawada in Trans. nat. Hist. Soc. Formosa, 32, 223, pp. 176-177, April 1942. [Japanese.]

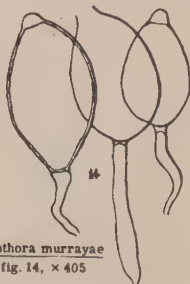
Mycelium aseptate, constricted at the passage through the host cell wall, without haustoria. Conidiophores hypophyllous, $52-88 \times 3-7\ \mu$, from the stomata enlarging towards the apex, bearing one conidium at the tip. Conidia broadly ellipsoidal to narrowly elliptic, commonly elliptic, papillate, $28-65 \times 19-37\ \mu$, averaging $45.32 \times 28.78\ \mu$ (200 measurements), with mode at $44 \times 28\ \mu$, and l/d ratio of 1.57.

Swarmspores escape through the rupturing papilla, opening $5-8\ \mu$ across. No oospores.

Parasitic on leaves, petioles, and young twigs of Murraya paniculata Jack, at Taipei, 13.6.1927.

When cultured on bean decoction agar at 25°C . it forms colonies as large as P. pini and P. cryptogea. However, the latter has smaller conidia, which are always blunt. P. pini has larger conidia with a papilla or not so developed, or entirely absent, and with oblique shape. In these respects the fungus differs from both.

[From a translation by Dr. C. T. Wei. Figures in Rep. Gov. agric. res. Inst., Formosa, 83, pl. I fig. 14, 1942. No Latin diagnosis.]



Phytophthora murrayae
— fig. 14, $\times 405$

PHYTOPHTHORA NICOTIANAE van Breda de Haan in Meded. PlTuin, Batavia, 15, p. 57, pl. 1, 1896.

≡ Nozemia nicotianae (van Breda de Haan) Pethybridge [see above, under Nozemia]

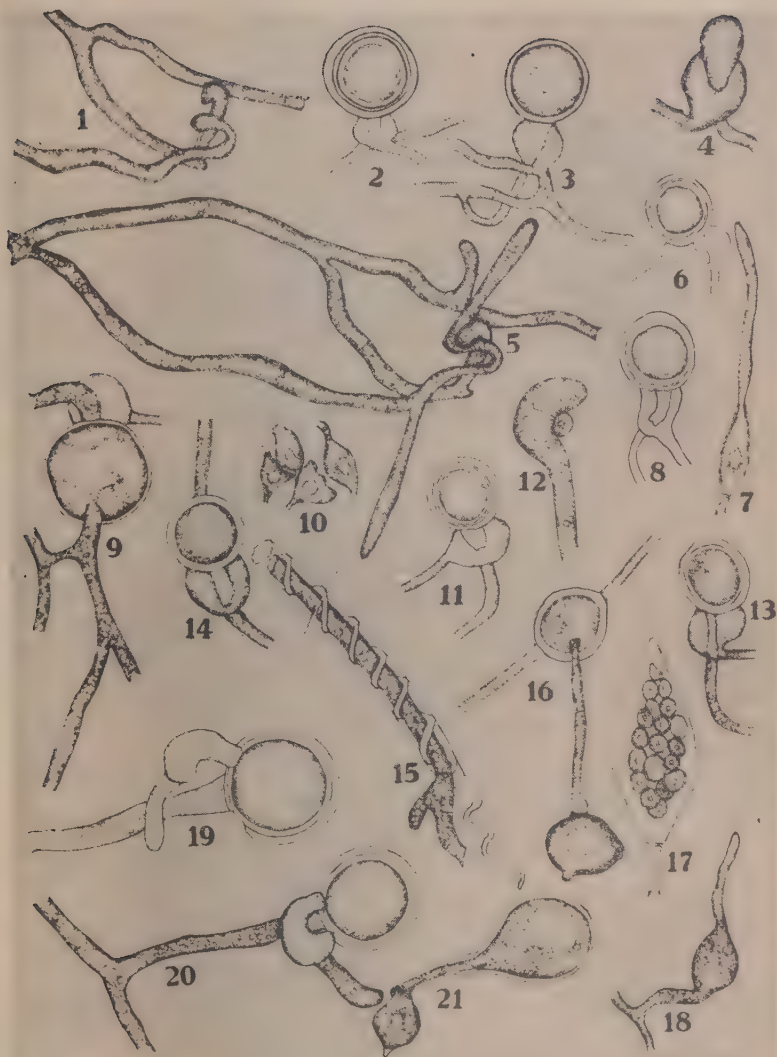
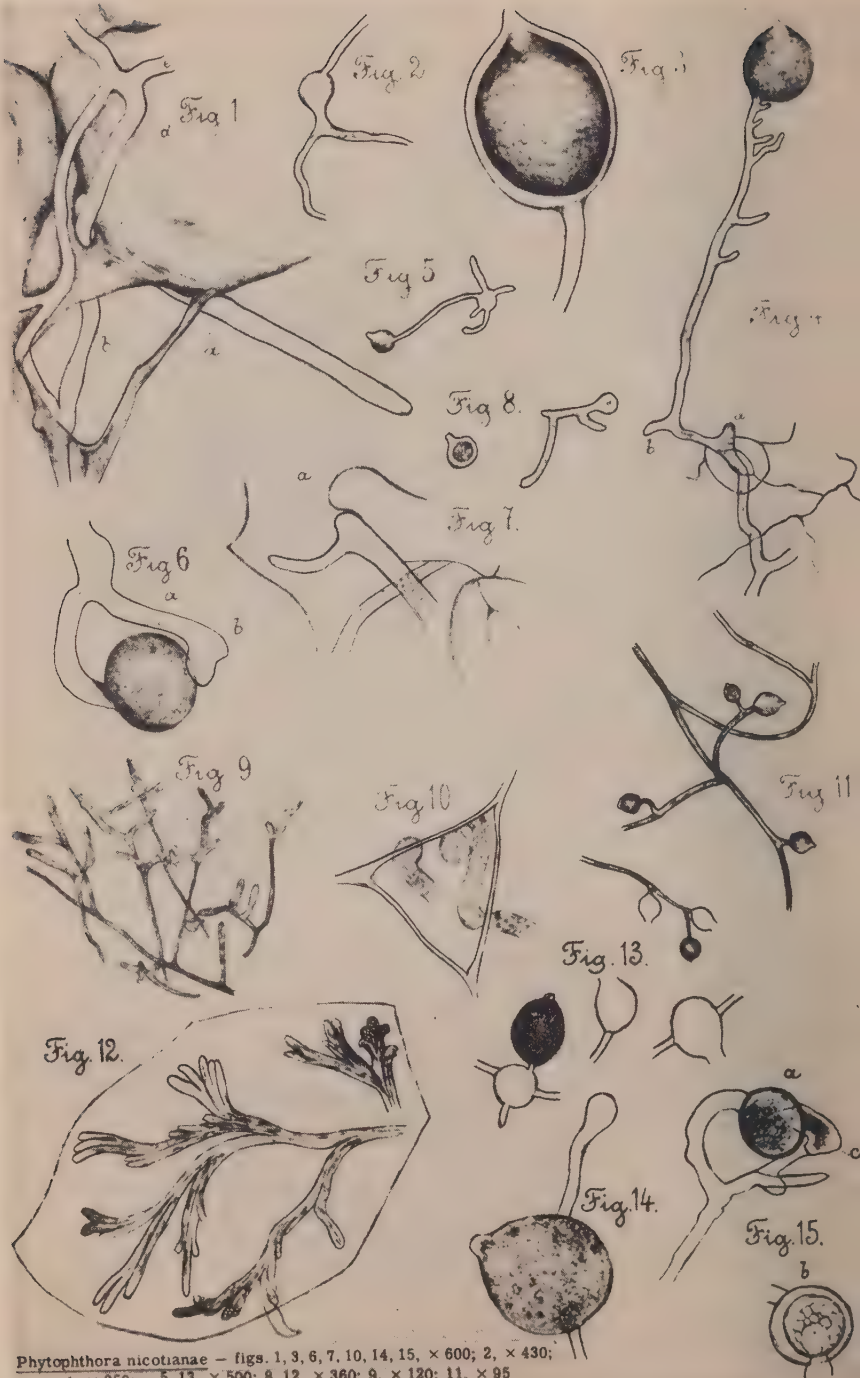


PLATE 23

Phytophthora mexicana



Phytophthora nicotianae — figs. 1, 3, 6, 7, 10, 14, 15, $\times 600$; 2, $\times 430$;
 4, $\times 250$; 5, 13, $\times 500$; 8, 12, $\times 360$; 9, $\times 120$; 11, $\times 95$

[Slightly reduced from original.]

≡ Phloeophthora nicotianae (van Breda de Haan) Wilson [see above, under Phloeophthora]

Voor de lengte der conidiën werd door ons gevonden 36 mikron bij 25 mikron breedte, in deze maten heerscht dus de meeste overeenstemming met laatstgenoemde Phytophthora phaseoli. Zoolang echter door cultuurproeven nog niet de biologische overeenstemming beider schimmels is aangetoond, kunnen wij aan de parasiet, welke op de tabaksplant voorkomt, den naam geven van Phytophthora nicotianae nov. spec.

[We found the conidia to be $36\ \mu$ long and $25\ \mu$ wide; these measurements thus completely agree with the last-mentioned Phytophthora phaseoli. While, however, the biological identity of the two moulds is not yet proved by culture experiments, we may call the parasite occurring on the tobacco plant Phytophthora nicotianae n. sp.]

No formal diagnosis is given but there is a fairly full description of the fungus, without, however, any measurements of the oogonia and antheridia. From the magnifications given with the figures the measurements of the oogonia can be calculated as $28 \times 25\ \mu$, $20 \times 16.6\ \mu$, and $23.3 \times 21.6\ \mu$, and the oospore $16.6\ \mu$ diam.]

PHYTOPHTHORA OMNIVORA de Bary in Bot. Zeit., 39, p. 619, pl. 5, figs. 33-41, September 1881; also in Abhandl. Senckenb. naturf. Gesellsch., 12, p. 22, pl. III figs. 9-27, 1881.

Unsere Phytophthora ist schon dreimal bekannt, 1874 P. cactorum, 1875 P. sempervivi und P. fagi. Nach Prioritätsrücksichten müsste sie unzweifelhaft hinfort P. cactorum heissen und die beiden andern Namen ausser Kurs gesetzt werden. Das wäre formell correct, sachlich aber doch verkehrt, denn es käme der unpassendste Name auf Grund einer ungenügenden Beschreibung zur Geltung, statt besserer und gut fundirter. Hier ist wohl eine Veranlassung, die Namenspriorität aufzugeben, und da dies doch einmal geschieht so habe ich einen neuen, nach Kräften bezeichnenden Namen gewählt.

[Our Phytophthora has been named three times already, in 1874 P. cactorum,



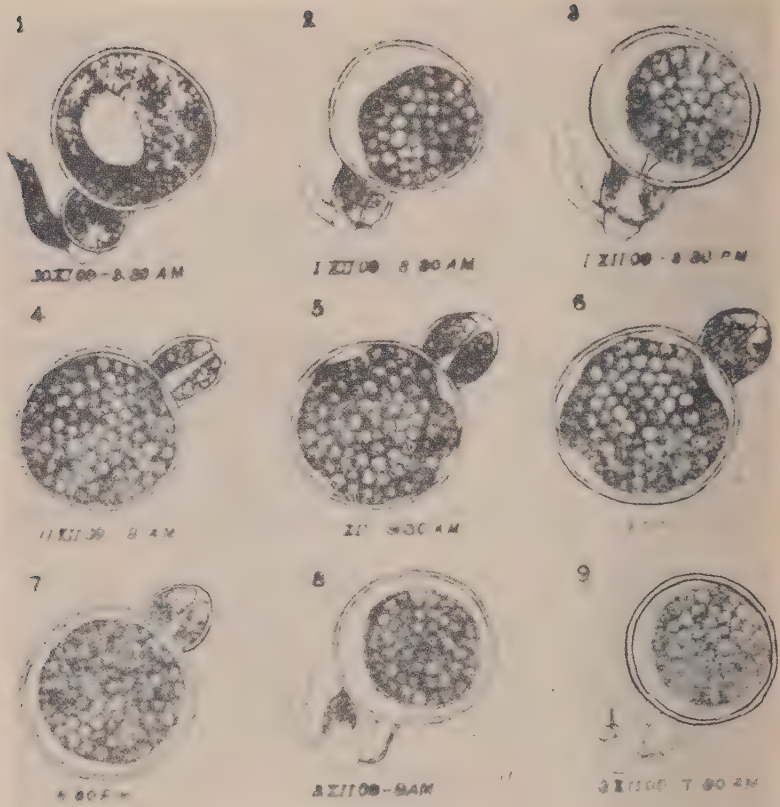


PLATE XVII

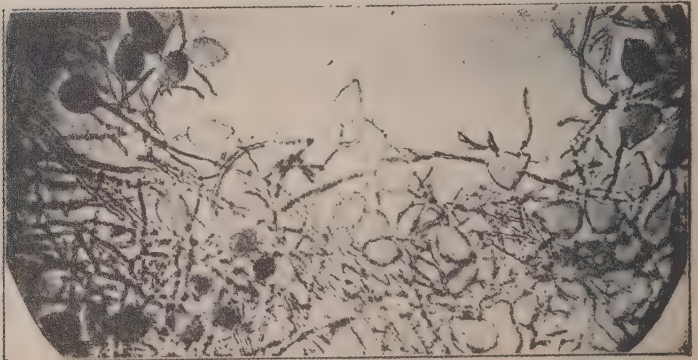


PLATE V, FIG. 3
Phytophthora omnivora var. arecae

in 1875 *P. sempervivi* and *P. fagi*. If considerations of priority were to prevail, it should henceforth doubtless be called *P. cactorum* and the other two names placed under synonymy. This would be formally correct, but nevertheless perverting reality, because the most unsuitable name based on an inadequate description would be accepted, instead of a better and well-founded one. This is obviously an occasion for relinquishing the prior name, and as this has already occurred once, I have chosen a new name indicating its potentialities.]

PHYTOPHTHORA OMNIVORA var. ARECAE Coleman in Bull. Dept. Agric.

Mysore, Mycol. Ser. 2, 1, p. 84, pl. V (fig. 3), XII (figs. 1-5), XV (figs. 1-4), XVI (figs. 1-5), XVII (figs. 1-10), XVIII (figs. 1-3), 1910; also in Ann. Mycol., 8, p. 620, October 1910.

Differs from the type in having large oospores, diameter $23\ \mu$ - $36\ \mu$. Sporangia usually as in *P. omnivora* but occasionally formed intercalary. Oospores not formed in artificial cultures on malt agar and potato, rarely if at all in nature on the host plant abundant on areca nuts in pure culture and on *Cereus* and *Clarkia elegans*. Mycelium inter- and intracellular, septate only in older stages. Haustoria sparse, finger-like, occasionally dichotomously branched. Habitat in bases of leaves, fruits, peduncles and apex of Areca catechu.

Habitat in bases of leaves, fruits, peduncles, and apex of *Areca catechu*. Distribution - Western Mysore, N. Canara, S. Canara, S. Malabar, and Cochin.



PLATE XVIII
Phytophthora omnivora var. *arecae*

PHYTOPHTHORA OMNIVORA PARASITICA f. ERIOBOTRYAE Dufrénoy in Rev. Path. veg., 14, 3, p. 201, 1st July 1927.

Nous avons pu isoler un *Phytophthora* de la marge de lésions du tronc de Néfliers du Japon (*Eriobotrya japonica*) à Bastia (Corse).

En culture, sur milieu gélosé, le *Phytophthora* forme des filaments mycéliens vigoureux, pourvus d'un énorme canal vacuolaire central, colorable en rouge jaunâtre ou en jaunâtre par le rouge neutre. Sur carotte, des oeufs, mesurant $25-27\ \mu$, se forment en très grande abondance, en quelques jours, par voie amphigène ou très rarement par voie paragène.

Pour obtenir les zoosporange, il faut transporter des fragments de jeunes cultures sur carotte dans une couche de liquide excessivement mince; le mycélium non submergé, rampant sur le fond humide du vase, forme des zoosporanges, en sympode très lâche.

Par ces caractères, ce *Phytophthora* nous paraît représenter une forme du groupe *P. omnivora parasitica*, et nous proposons de le nommer *P. omnivora parasitica* forme *eribotryae*.

[We were able to isolate a *Phytophthora* from the margin of the lesions on the trunk of Japanese medlar (*Eriobotrya japonica*) at Bastia (Corsica).

In culture on an agar medium the *Phytophthora* formed vigorous mycelial filaments, provided with a large central vacuolar canal, stainable reddish yellow or yellow by neutral red. On carrot, the oospores, measuring $25-27\ \mu$, form in very great abundance in a few days, amphigynous or very rarely paragynous.

To obtain zoosporangia it is necessary to put fragments of young cultures on carrot into an extremely shallow layer of liquid; the mycelium not submerged,

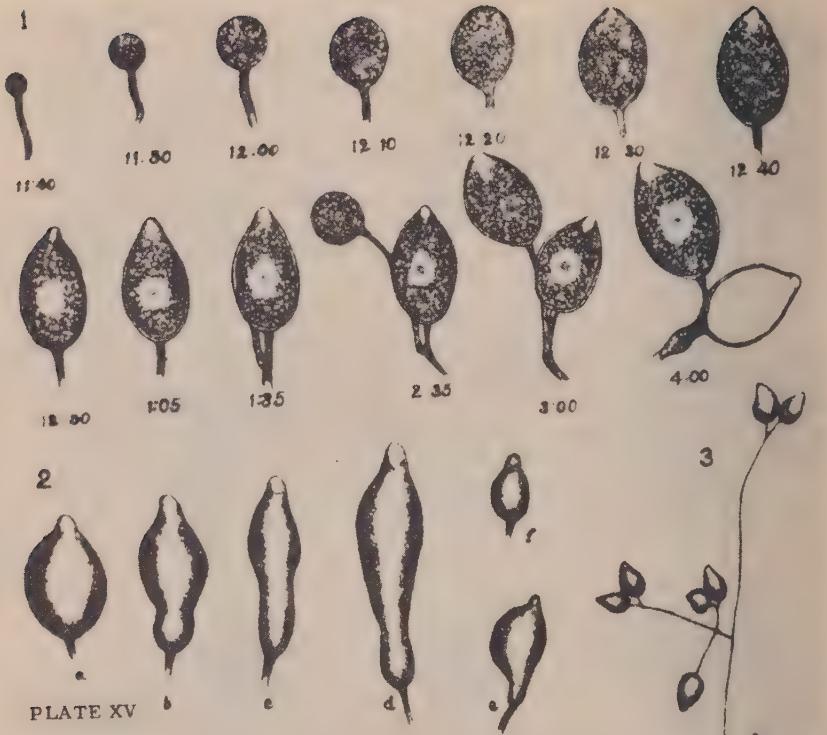
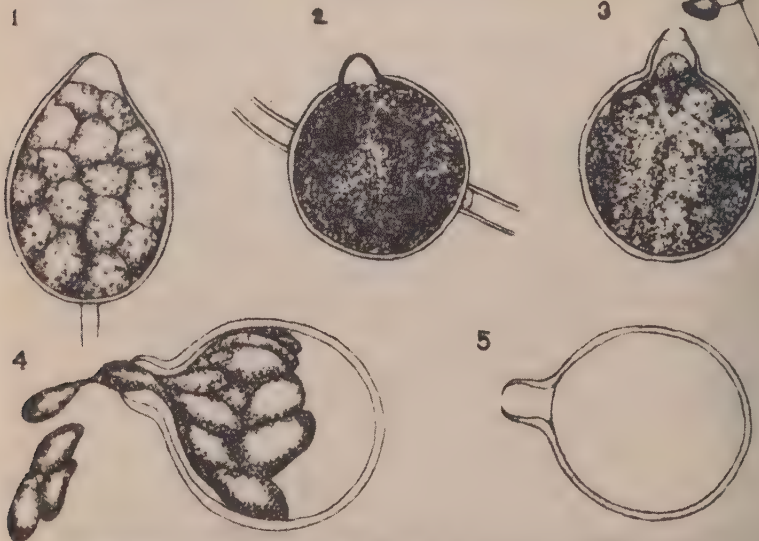


PLATE XV

PLATE XVI



Phytophthora omnivora var. *arecae* — pl. V, fig. 3, $\times 200$; pl. XV, fig. 1, $\times 350$; 2, $\times 425$, 3, $\times 4100$; pl. XVI, fig. 1, $\times 775$; 2-5, $\times 850$; pl. XVII, figs. 1-9, $\times 670$; pl. XVIII, figs. 1-3, $\times 850$

growing rapidly over the wet base of the dish, forms zoosporangia in very lax sympodia.

From these characters this *Phytophthora* appears to us to represent a form of the group *Phytophthora omnivora parasitica*, and we propose to name it *Phytophthora omnivora parasitica* f. *eriobotryae*.]

SCLEROSPORA ORYZAE Brizi in *Natura*, Milano, 10, p. 173, 1919.

I conidiofori sono quasi sempre due, di rado tre, brevi grossi, a diametro irregolare, poco ramificati e portano generalmente all' apice tre o quattro brevi sterigma a quali sono attaccati altrettanti conidi globosi, piccoli, i quali, germinando danno sei otto zoospore. . . . identiche a quelle die si formano dalla germinazione delle oospore. Le grosse oospore, racchiuse nella parete oogoniale anch' essa, assai spessa, sono angolose e rugose, ma non sferiche e lisce come nella tipica *S. macrospora*.

[The conidiophores are nearly always in pairs, very rarely in threes, short and thick, of irregular diameter, slightly branched and generally bearing at the apex three or four short sterigmata to which are attached many small, globose conidia which on germination give six to eight zoospores. . . . identical with those formed on the germination of the oospores. The large oospores, enclosed by the oogonial wall, which is also quite thick, are also angular and rugose, but not spherical and smooth as in typical *S. macrospora*.

Brizi also adds. . . ' the thickness of the oogonial wall is very variable, with red tints. The parasite on rice is sufficiently distinct from *S. macrospora* and *S. graminicola*, particularly in the size of the oospores and the branching of the conidiophores, to be called *S. oryzae*. The oospores measure 45-65 μ .']

PHYTOPHTHORA ORYZAE (Brizi) Hara, Ine no Byogai [Rice plant diseases], November 1939.

[Original not seen.]

PHYTOPHTHORA PAEONIAE Cooper & Porter *Phytopathology*, 18, p. 897, pl. 29, text fig. B₁, November 1928.

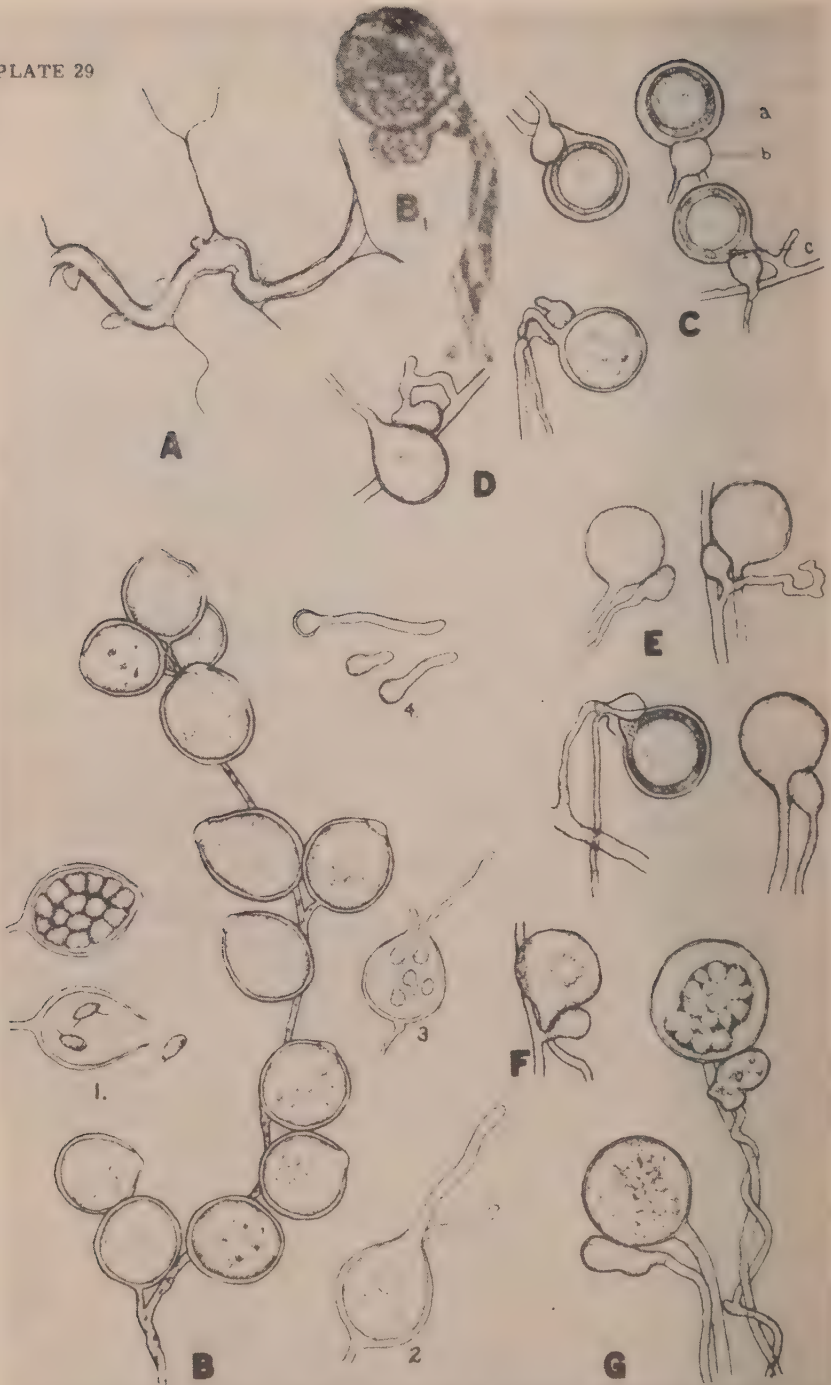
Mycelium at first continuous and granular somewhat geniculate, later becoming vacuolate and finally sparingly septate, 7-10 μ in diameter, intercellular, producing small sub-spherical haustoria; conidiophores not distinguishable from the mycelium; produced on mycelium of colony from 4 to 5 days old; bear from 1-15 conidia; conidia terminal on short unbranched lateral hyphae, normally ovate and papillate, the papillae being usually broad and flat; conidia measure 22.5-35.6 μ by 26.2-41.2 μ , mostly 26-28 μ by 31-33 μ , germinating by zoospores, sometimes by germ tube; zoospores biciliate, 8-10 μ by 10-12 μ , becoming globose, and 8-10 μ in diameter; chlamydospores few, 30-40 μ in diameter; oogonia in abundance on mycelium from 24 to 48 hours old and older, 26-34 μ in diameter, pale to brownish in colour; antheridium oval to globose, closely appressed to base of oogonium at side of oogonial stalk; oospores globose, thick walled, 24-30 μ in diameter; formed profusely on most culture media.

Parasitic on the tips, stalks, and leaves of Peony in Indiana, Pennsylvania, Connecticut, and Kansas, U. S. A.

PYTHIUM PALMIVORUM Butler in *Mem. Dep. Agric. India*, *Bot.*, 1, 5, pp. 82-83, pl. IV figs. 2-10, February 1907.

Mycelium intercellular, only haustoria passing into the cells; hyphae large, often irregularly swollen, up to 7 μ in diameter, ramifying between the cells of the parenchyma; sporangia *Phytophthora*-like, inverted pear-shaped or, more rarely, round, and always terminal. They germinate readily in water, giving rise to rather large zoospores, formed in the manner typical of *Pythium*. The sporangia measure 50 $\times$ 35 μ , on an average (extremes 38-72 $\times$ 33-42), and the

PLATE 29



Phytophthora paeoniae — all figures, except B, $\times 400$; B, no magnification given

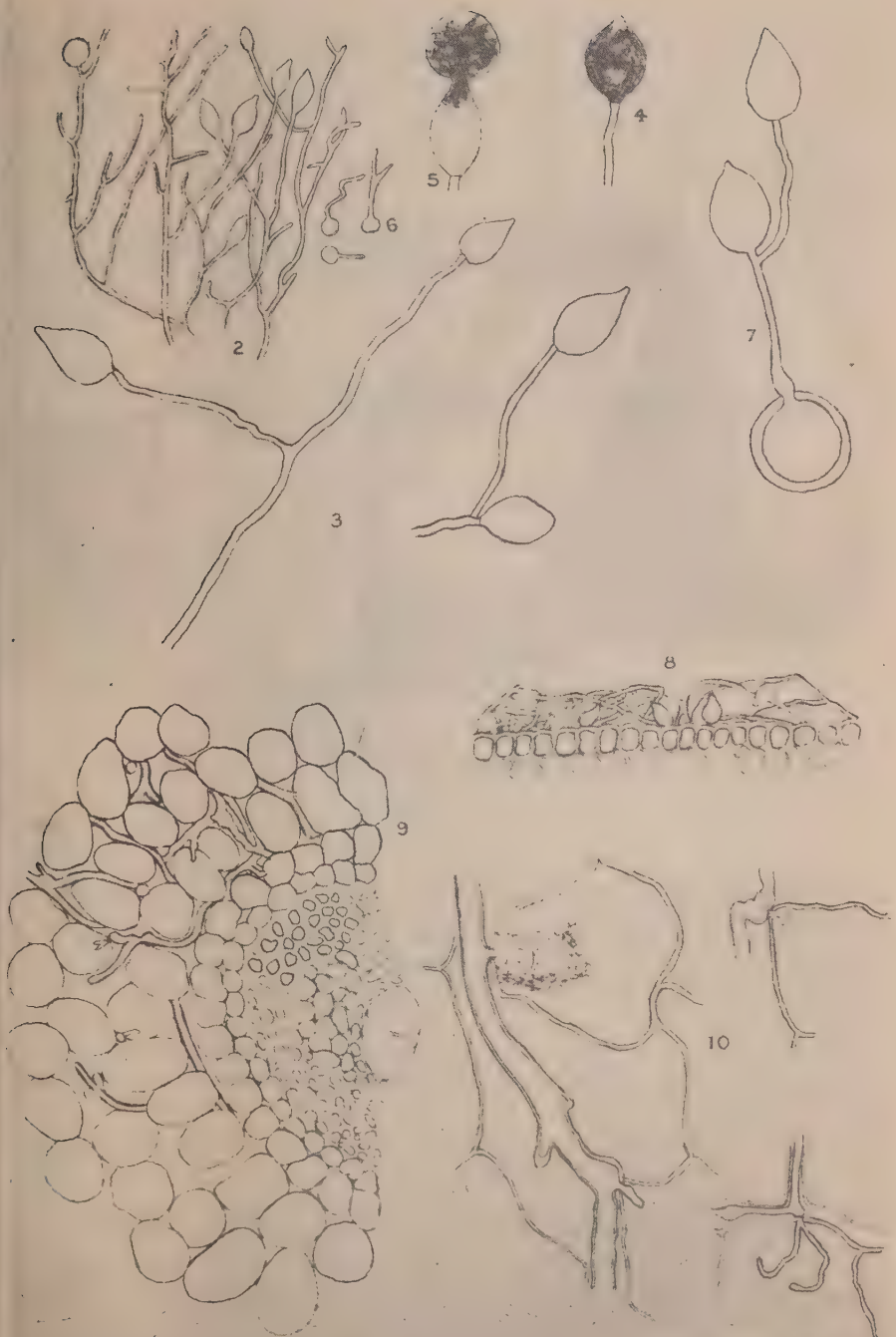


Fig. 2, *Pythium palmivorum* — fig. 2, $\times 100$, 3-5, $\times 260$; 7, $\times 400$; 9, $\times 260$; 10, $\times 940$

zoospores, after coming to rest, 8-10 μ . Oospores spherical, measuring 35-45 μ in diameter, the walls being up to 4 μ thick. They germinate readily, giving rise to a short branch on which sporangia are early formed.

Parasitic on *Borassus flabellifer*, *Cocos nucifera*, and (?) *Areca Catechu*, Godavery, India.

PHYTOPHTHORA PALMIVORA (Butler) Butler in *Sci. Rep. agric. Res. Inst. Pusa* 1918-19, p. 82, 1919.

Cultures [of another species attacking coconuts in Jamaica] sent to the writer have proved to be identical with his *Phytophthora palmivora*, first described under the name *Pythium palmivorum*.

PHYTOPHTHORA PALMIVORA var. PIPERIS Muller in *Meded. Inst. PlZiekt.*, Buitenz., 88, p. 70, 1936.

The specificity for Piper and the high temperature optimum for growth on potato dextrose agar (31°C.) are considered to be sufficient reasons for regarding the pepper strains as a separate variety. . . . [No Latin diagnosis.]

PHYTOPHTHORA PARASITICA Dastur in *Mem. Dep. Agric. India Bot.*, 5, 4, p. 226, pls. II, IV, VI, VII, May 1913.

Maculis amphigenis, orbicularibus, centro areolatis, dilute umbrinus, anulatis, solitariis vel confluentibus; mycelio intermatricali, ex hyphis inter- et intracellularibus, primo continuis tandem septatis, 3-9 μ crassis, constantibus; haustoriis sparsis, digitatis vel subglobosis, raro ramosis, sporangio- phoris 100-300 μ longis, sporangis terminalibus, interdum intercalaribus vel lateralibus, plerumque ovoideis, subinde globosis 25-50 $\times$ 20-40 μ ; zoosporis 8-12 $\times$ 5-8 μ ; sporis perdurantibus globosis, flavidis, 20-60 μ , membrana crassa, levi; oogoniis et antheridiis in vitro cultis; oogoniis intercalaribus vel lateralibus, globosis, levibus vel rugosis, melleis, 18-25 μ (23.8 μ), pedicellis per antheridia penetrantibus; oosporis globosis, 15-20 μ , (18.6 μ), membrana crassa, mellea, levi.

Hab. in foliis seminisque Ricini communis et Sesami indicii. Indiae orient.

[Spots on both sides, spherical, centre dry, pale umber, annulate, solitary or confluent; mycelium intramatricial, from inter- and intracellular hyphae, at first continuous, at length septate, 3-9 μ wide, firm; haustoria rare, digitate or subglobose, rarely branched, sporangio-phores 100-300 μ long, sporangia terminal, sometimes intercalary or lateral, commonly ovoid, frequently globose 25-50 $\times$ 20-40 μ ; zoospores 8-12 $\times$ 5-8 μ ; resistant spores globose, yellow, 20-60 μ , wall thick, smooth; oogonia and antheridia in culture; oogonia intercalary or lateral, globose, smooth or wrinkled, honey-coloured, 18-25 μ (23.8 μ), stalk penetrating the antheridium; oospores globose, 15-20 μ (18.6 μ) wall thick, honey-coloured, smooth.]

Hab. in leaves and seeds of *Ricinus communis* and *Sesamum indicum*. In the east of India.]

PHYTOPHTHORA PARASITICA var. CAPSICI (Leonian) Sarejanni in *Ann. Inst. phytopath.* Benaki, 2, 1, p. 44, 1936 [1937].

..... qui serait aussi une espèce polyphage, mais qui, quoiqu'il ressemble morphologiquement au *P. parasitica*, a la faculté d'attaquer les jeunes plantules de piment, ce que ne font pas, paraît-il les *P. parasitica* typiques;.....

[..... which was also a polyphagous species, but which, while resembling morphologically *P. parasitica*, has the ability to attack young pepper seedling, which, it appears, typical *P. parasitica* cannot do;... No Latin diagnosis.]

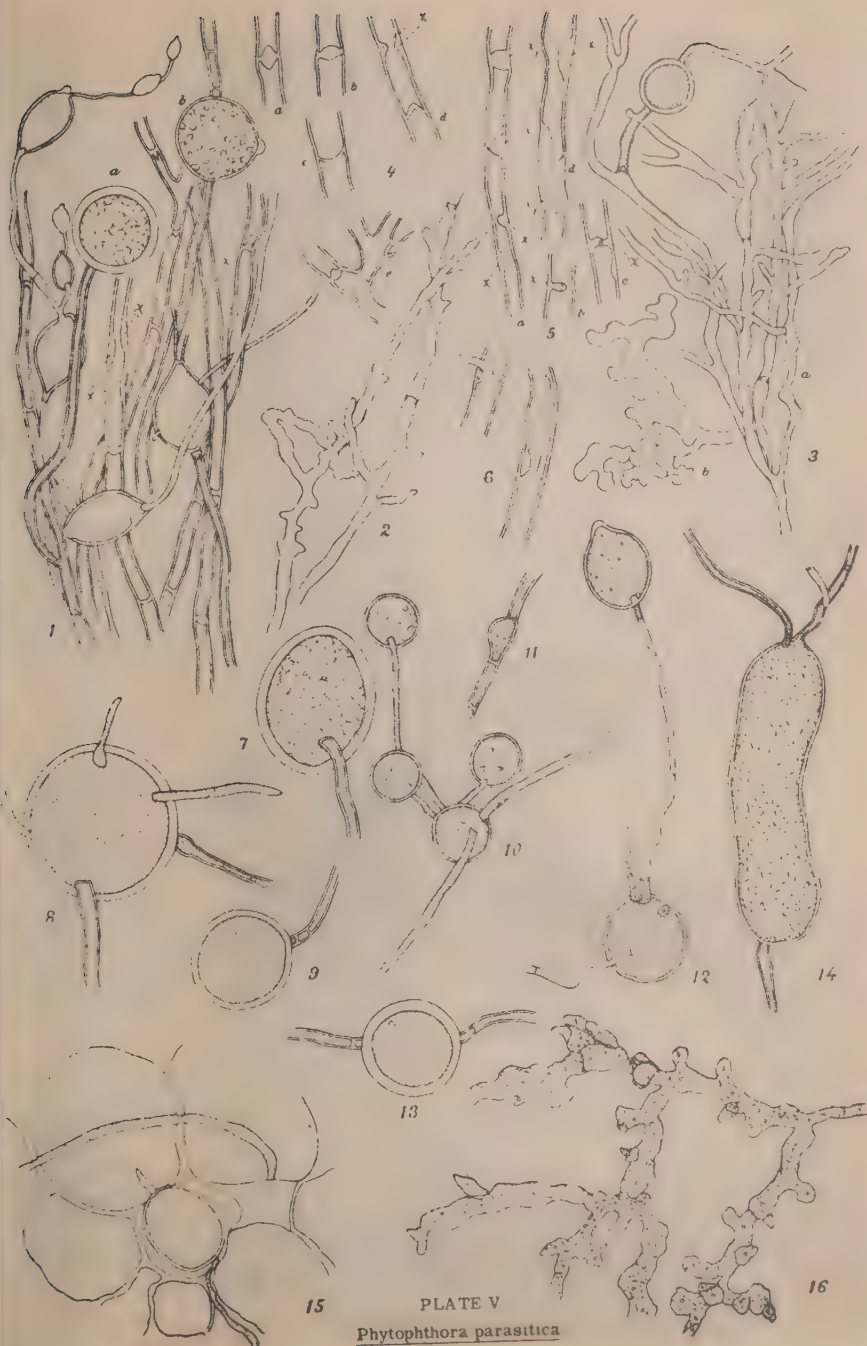
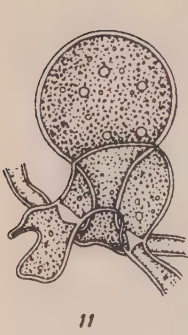
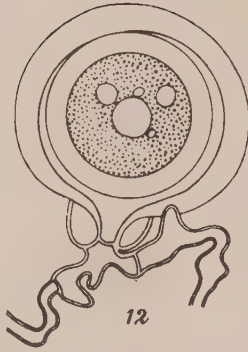


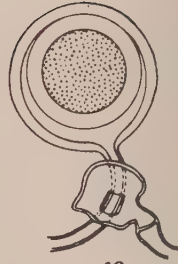
PLATE V
Phytophthora parasitica



11



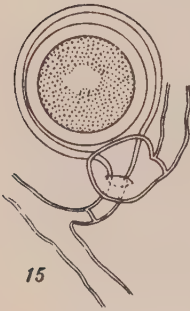
12



13



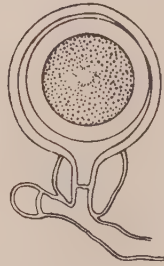
14



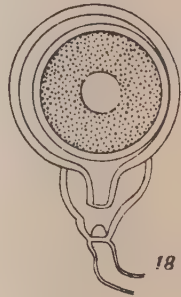
15



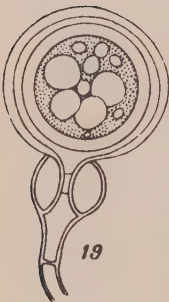
16



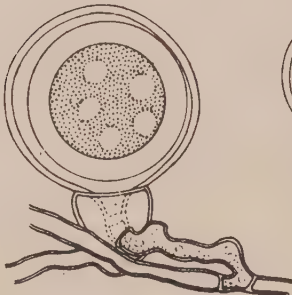
17



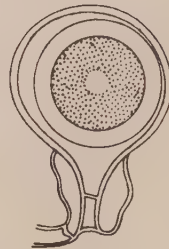
18



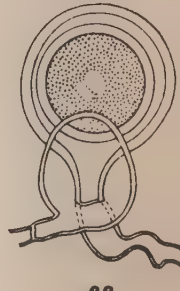
19



20.



21



22

PLATE VI
Phytophthora parasitica

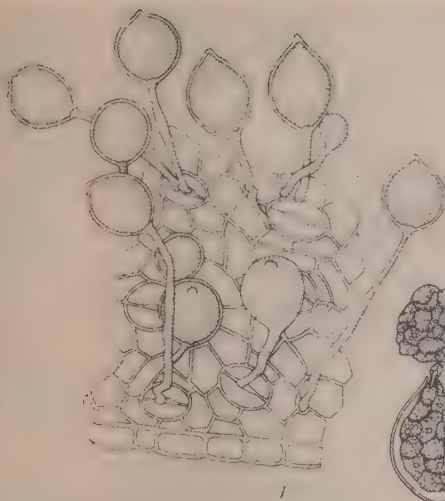


PLATE II

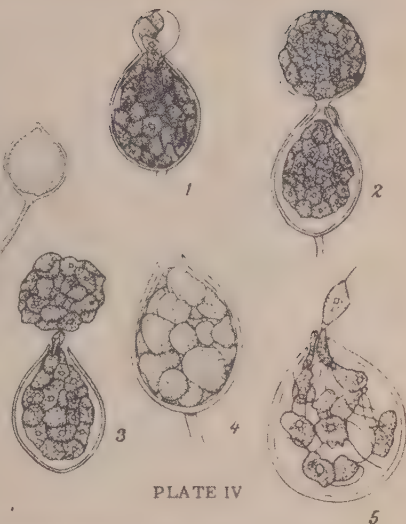


PLATE IV

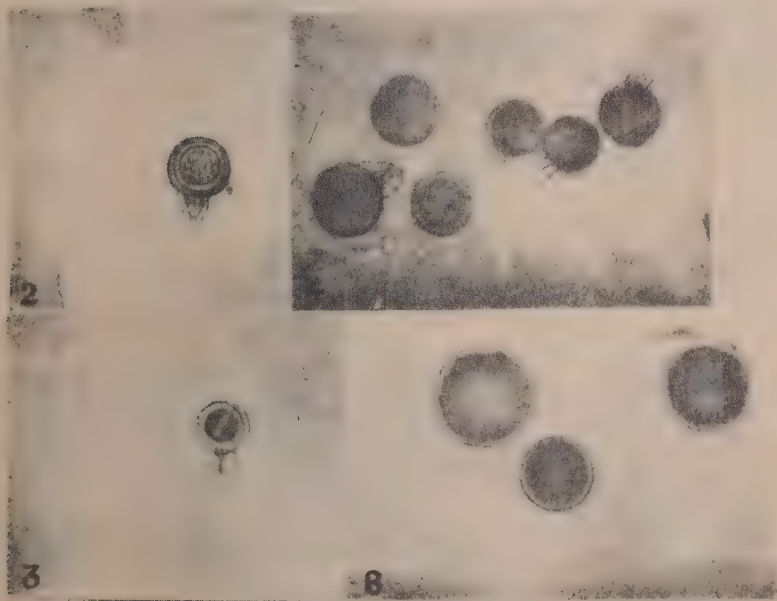


PLATE VII

Phytophthora parasitica — pl. II, fig. 1, $\times 320$; pl. IV, figs. 1-4, $\times 405$; 5, $\times 640$; pl. V, figs. 1, 3, 7-9, 11-16, $\times 405$; 4-6, $\times 640$; 10, $\times 100$; pl. VI, figs. 11-22, $\times 1,165$; pl. VII, $\times 400$

PHYTOPHTHORA PARASITICA var. COLOCASIAE (Raciborski) Sarejanni in ibid., p. 47.

..... le P. colocasiae est une espèce relativement mal connue, et le qualificatif 'colocasiae' conviendrait mieux à caractériser des souches à pouvoir pathogène limité, ou du moins s'étendant à la Colocasia esculenta, souches, qu'on ferait dans notre système appartenir au P. parasitica var. colocasiae.

[..... P. colocasiae is a relatively poorly known species, and the epithet 'colocasiae' would be more fitting to characterize strains with pathogenic ability limited, or at least extending to Colocasia esculenta, strains which in our system would belong to P. parasitica var. colocasiae. No Latin diagnosis.]

PHYTOPHTHORA PARASITICA var. NICOTIANAE Tucker in Res. Bull. Mo. agric. exp. Sta. 153, p. 173, June 1931.

Differs from P. parasitica Dastur (emend. Ashby) only in attacking the roots, stems, and leaves of tobacco (Nicotiana tabacum) at any stage of growth, causing the widely distributed and important disease known as black shank.

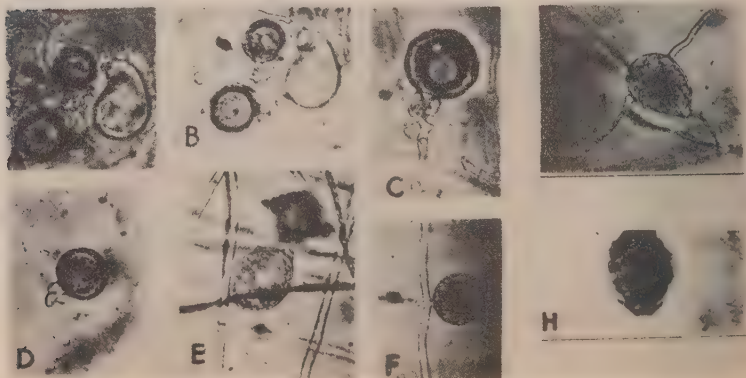
PHYTOPHTHORA PARASITICA var. PIPERINA Dastur in Proc. Indian Acad. Sci., Sect. B, I, 11, p. 805, May 1935.

Hyphae generally intercellular, sometimes intracellular; haustoria absent; sporangia pear-shaped or broadly ovate with a prominent papilla; measuring 30-63.3 by 20.4-40.8 μ ; motile zoospores bean-shaped and biciliate; resting zoospores spherical measuring 2.2-5.7 μ ; chlamydospores similar to those of P. parasitica Dastur; oogonia at first hyaline, smooth and thin-walled and spheroidal; after fertilization thick and smooth or rough walled, yellow or yellow brown coloured; measuring 20.4-40.8 μ , average 33.4 μ ; antheridia hyaline, thin walled, persistent and amphigynous; one antheridium per oogonium; oospores spherical almost filling the oogonium, smooth and thick walled hyaline or very pale yellow coloured; measuring 17.8-53.1 μ , average 20.1 μ .

Parasitic on roots, underground stems and leaves of Piper betle and on roots of Piper longum.

[No Latin diagnosis.]

PHYTOPHTHORA PARASITICA var. RHEI Godfrey in J. agric. Res., 23, 1, p. 21, pls. 8, 9, 10, January 1923.



Phytophthora parasitica var. rhei PLATE 10 no magnification given

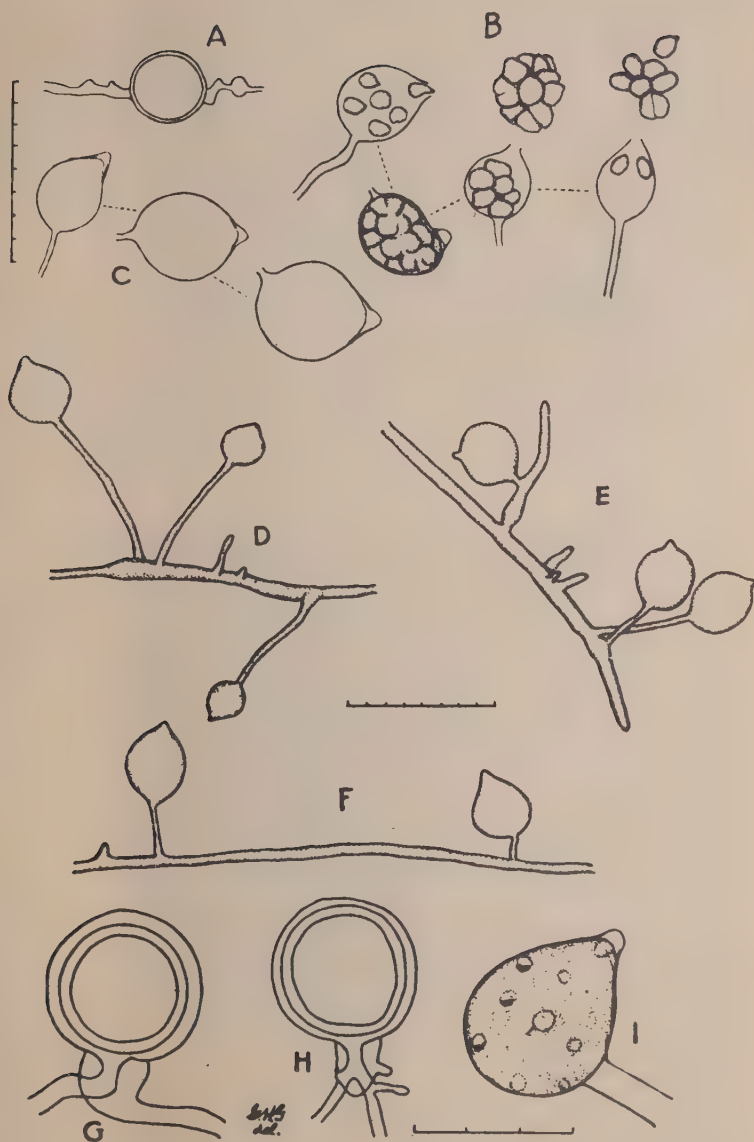


PLATE 8

Phytophthora parasitica var. *rhei* — pls. 8, 9, each scale division = 1/100 mm;

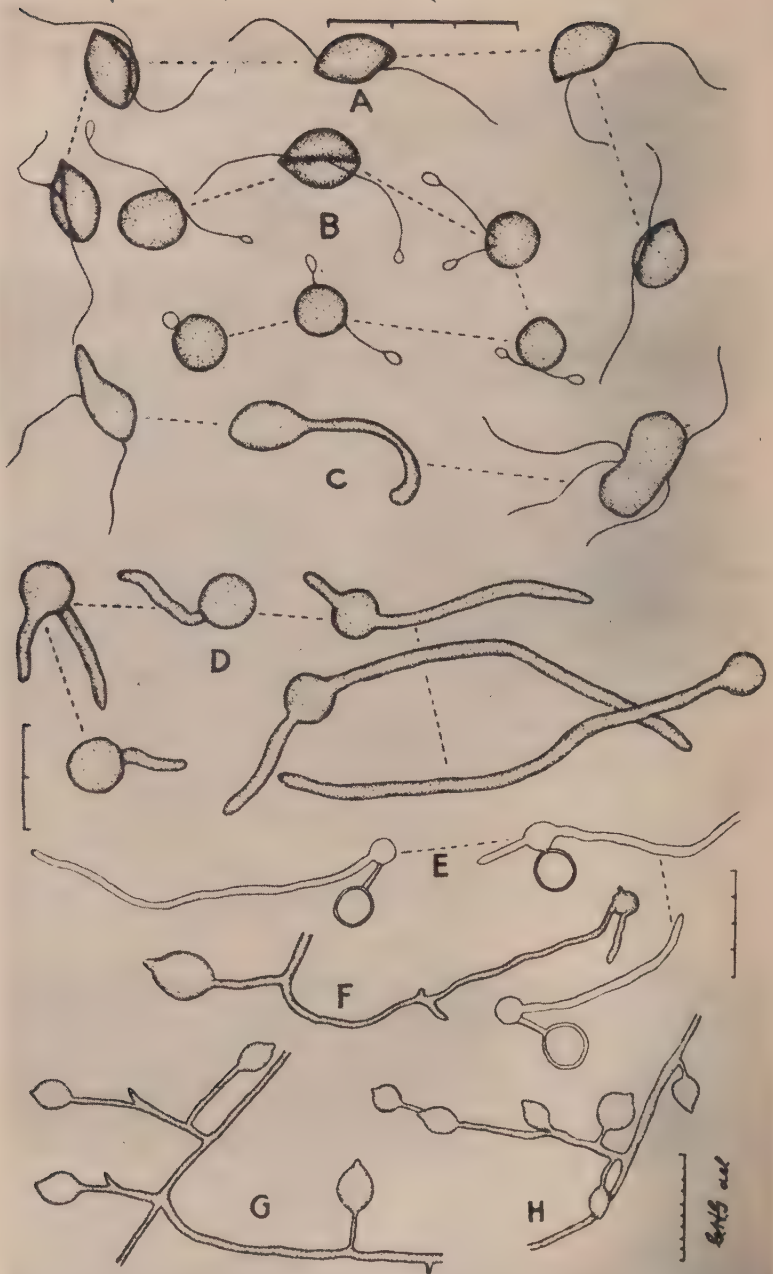


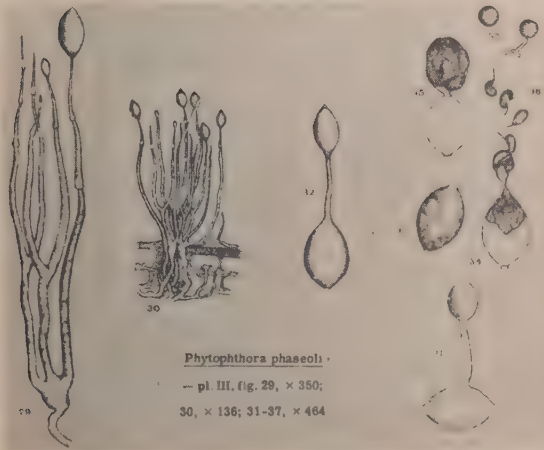
PLATE 9

Phytophthora parasitica var. *rhei*

Mycelium at first continuous, later sparingly septate; 5 to 15 μ in diameter, mostly intercellular, producing haustoria which may be small and subspherical, or finger-like; sporangiophores not distinguishable from the mycelium; sporangia terminal sometimes intercalary, normally ovate and papillate, sometimes spherical and lacking papillae, 21 to 42 μ by 27 to 54 μ , mostly 24 to 35 μ by 36 to 48 μ , germinating by zoospores, rarely by germ tube; zoospores biciliate, 8 to 9 μ by 11 to 13 μ , becoming globoid, 8 to 10 μ in diameter; chlamydospores globose, 27 to 42 μ ; walls thick; oogonia in abundance in old cultures, 24 to 33 μ in diameter, pale to brownish in color, penetrating through antheridium which remains attached at base; antheridia variable; oospores, globose, thick-walled, 21 to 30 μ , mostly 24 μ in diameter; growing profusely on most vegetable culture media.

Parasitic in base of leaf petioles and roots of rhubarb (*Rheum rhaponticum* L.) in Maryland, District of Columbia, and Virginia, United States of America; type locality, District of Columbia; type culture in Bureau of Plant Industry, Washington, D. C.

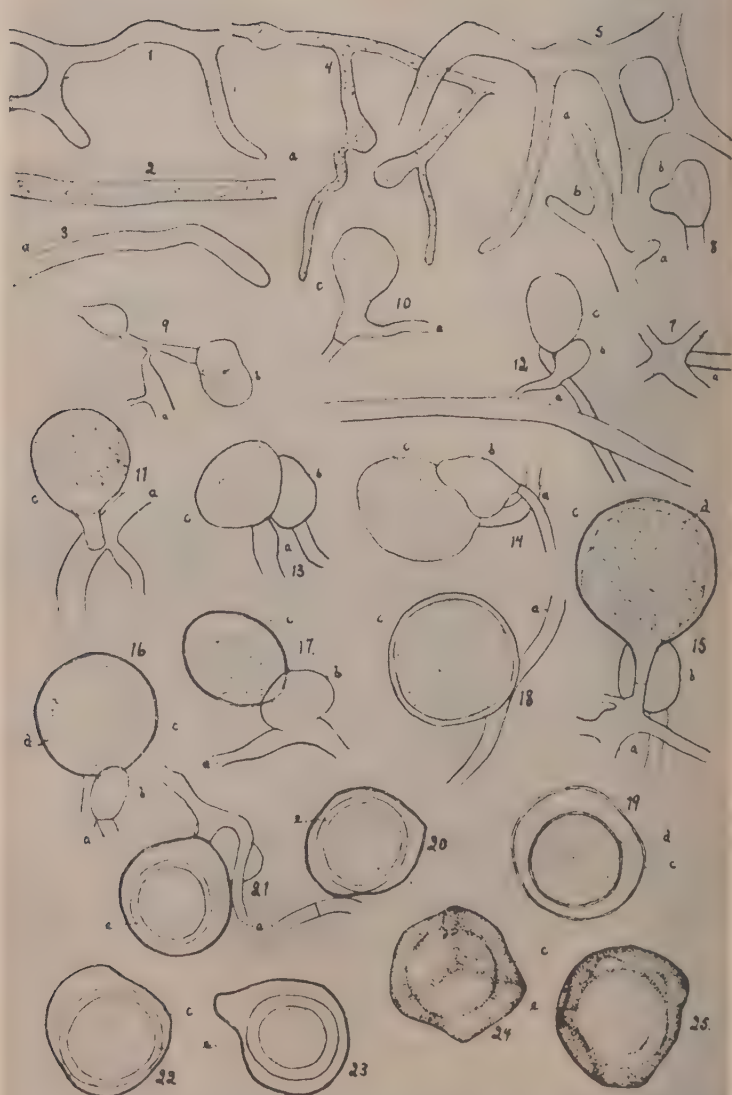
PHYTOPHTHORA PERSICA Sawada reported to have been published in Agric. Mag. Formosa, 38, 2, p. 95, 1942.



PHYTOPHTHORA PHASEOLI Thaxter in Bot. Gaz., 14, 11, p. 273, November 1889 [diagnosis]; figures in Rep. Conn. agric. Exp. Sta. 1889, pl. III (figs. 29-37), 1890.

≡ P. infestans var. phaseoli (Thaxter) Leonian [q. v.]

Mycelial hyphae branched, rarely penetrating the cells of the host by irregular haustoria. Conidiophores slightly swollen at their point of exit through the stomata, arising singly or one to several in a cluster; simple or once dichotomous.



Phytophthora phaseoli — pl. XX, × 600

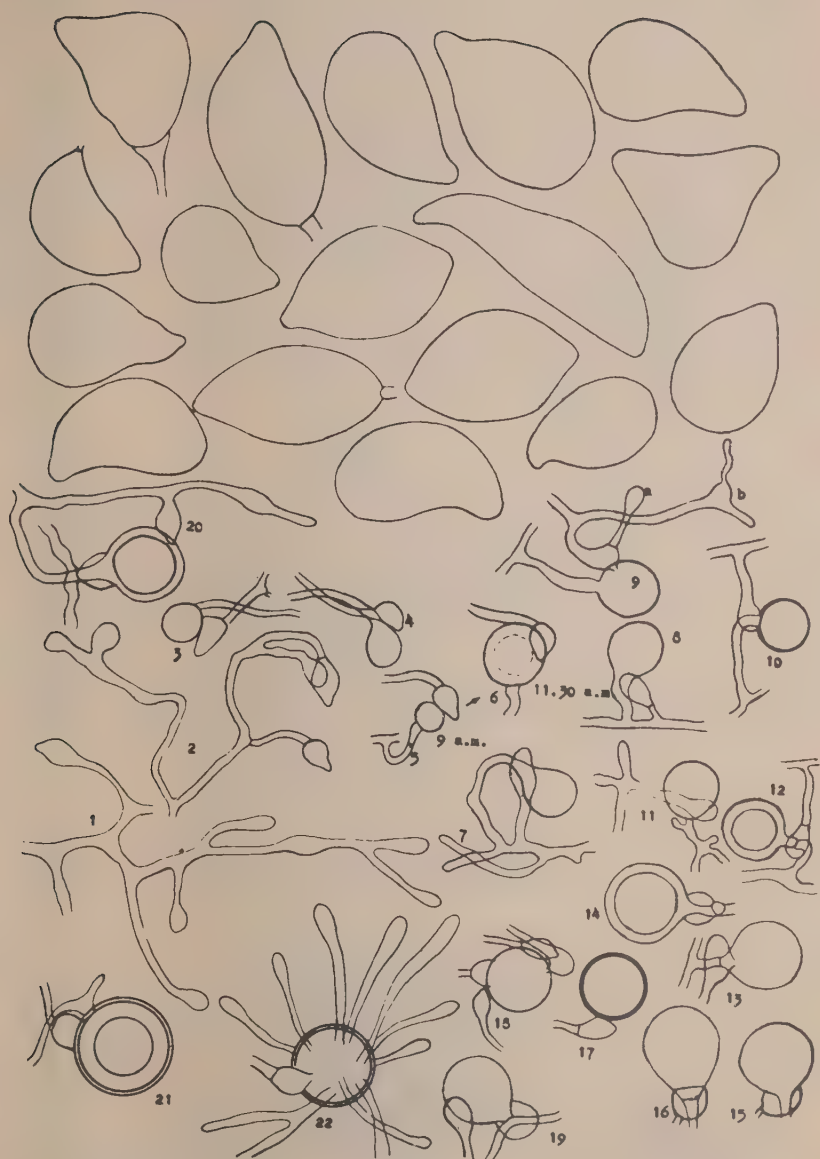


PLATE 57

Phytophthora pini — no magnification given

tomously branched, and once to several times successively inflated below their apices. Conidia oval or elliptical, with truncate base and papillate apex; $35-50\ \mu \times 20-24\ \mu$. Germination by zoospores, usually fifteen in number, or rarely by a simple hypha of germination. Oospores unknown.

On pods, stems and leaves of the Lima bean (*Phaseolus lunatus*),
New Haven, Connecticut, September and October.

Clinton, G. P. in *Rep. Conn. agric. Exp. Sta.* 1905, p. 293, pl. 20, 1906, adds:

Oogonia inter- or intracellular in seed coats or cotyledons of seeds, occasionally in tissues of pods and more rarely imbedded in mycelium on surface of seeds and pods, with rather thin scarcely folded walls loosely enclosing oospore, at first hyaline or slightly tinted but finally reddish brown, subspherical, chiefly $23-38\ \mu$ in diameter. Oospores spherical or sometimes subspherical, with apparently smooth and moderately thick walls ($2.5-4\ \mu$, chiefly $3\ \mu$ in thickness), hyaline or light yellowish, $18-26\ \mu$, chiefly $19.5-22.5\ \mu$ in diameter. Antheridia temporary, hyaline, variable, sometimes irregular but chiefly ovoid to ovate, usually applied to oogonia near their place of attachment to the mycelium, chiefly $8.5-11.5\ \mu$ in width by $14-17\ \mu$ in length.

PHYTOPHTHORA PINI Leonian in *Amer. J. Bot.*, 12, 7, p. 492, pl. 57, July 1925.

Sporangia large, terminal, rarely intercalary, usually ovate and papillate, but spherical, oblong and plano-convex forms not uncommon; papillae well defined or blunt, sometimes lacking altogether; mean length of sporangia $55.5\ \mu$, mean width $35\ \mu$, varying from $26-92.5 \times 22-44.5\ \mu$; oogonia formed in solid agars, but also abundantly in nutrient solution and when mycelium is transferred to M/100 sugars or even to distilled water; mean size of oogonia $29\ \mu$, varying from 18.5 to $37\ \mu$. Antheridia both paragynous and amphigynous, more commonly paragynous, usually only one antheridium on each oogonium, but two, three, and even four antheridia may be attached to the same oogonium; both types of antheridia on the same oogonium not uncommon; antheridia originating on the oogonial branch of developed in great numbers on distinct antheridial hyphae.

Weak parasite on roots of *Pinus resinosa* in Minnesota.

[Parts underlined were in italics in the original.]

PHYTOPHTHORA PINI var. ANTIRRHINI Sundararaman & Ramakrishnan in *Mem. Dep. Agric. India Bot.*, 16, 3, p. 99, pls. IV, V, VI, VII, 28th April 1928.

PLATE 7

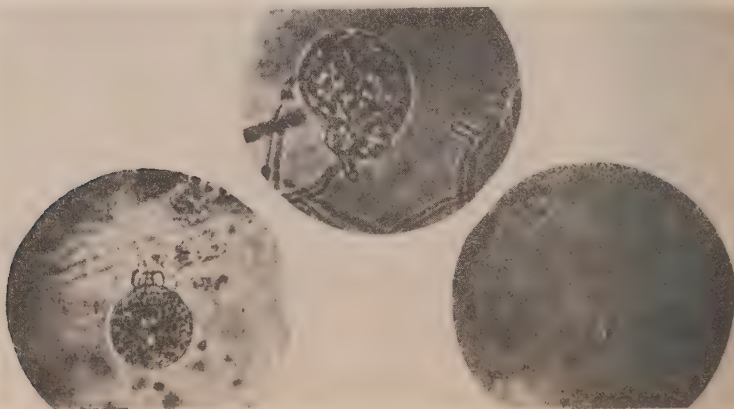


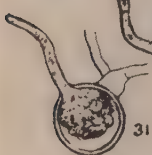
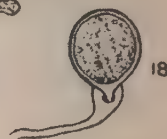
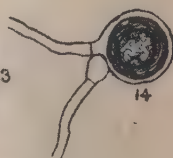
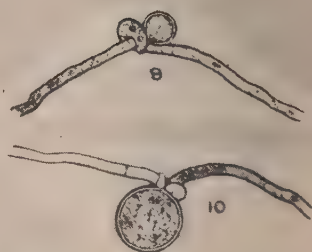
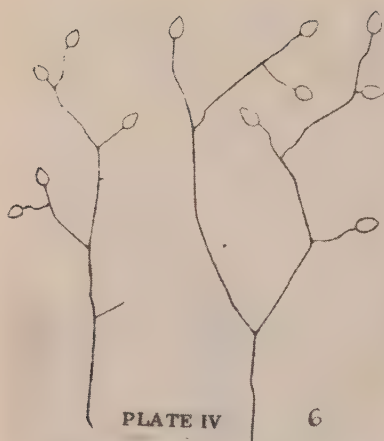


PLATE V

Phytophthora pini v. *antirrhini* — no magnification given

Phytophthora pini var. *antirrhini*

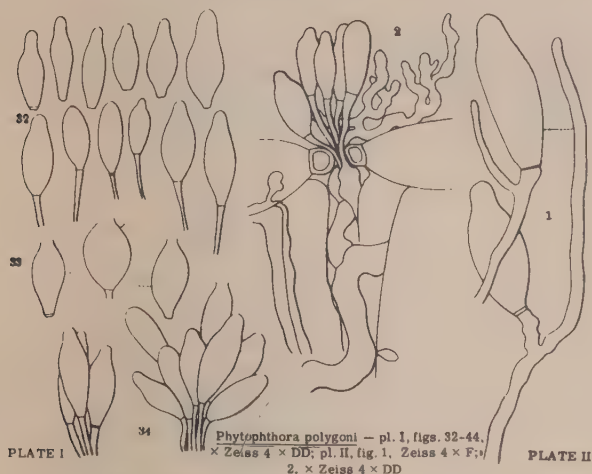
PLATE VI



Sporangia produced but rarely in agar cultures and abundantly in water, terminal, never intercalary, ovate or pear shaped, sometimes globose, papillate with a prominent papilla, $41 \times 30 \mu$ on an average (varying from $18-66.8 \times 12-42.8$). Oospores produced in plenty on solid media, 26.2μ mean diameter, spherical with a thick wall and lying inside a persistent oogonium which it does not completely fill, yellowish to reddish brown in colour; oogonia 30.87μ mean diameter; antheridia both paragynous and amphigynous, more commonly paragynous, on solid media.

Differs from *P. pini* in the larger, never intercalary sporangia, and the larger oogonia; one antheridium only; parasitism restricted to antirrhinum.

A parasite on Antirrhinum majus on the Nilgiris.



PHYTOPHTHORA POLYGONI Sawada in Spec. Bull. Govt Res. Inst. Taihoku 2, p. 32, pl. I figs. 32-34, pl. II figs. 1-2, December 1922. [Japanese]

≡ *Kawakamia polygoni* (Sawada) Sawada in Agric. mag. Formosa, 38, 5, p. 351, 1942.

Maculis in foliis primo flavo-viridis dein fulvis vel brunneis, effusis; hyphis intercellularibus, $5-15 \mu$ latis; conidiophoris tenellissimis, $4-20$ e stomatibus coalitis, simplicibus vel infra sporangium sympodice ramosis, $15-75 \mu$ longis, $1.5-5 \mu$ latis; sporangiis oblongatis vel citrifformibus, forma variis, apice papilla conica orantis, $17-41 \times 4-20 \mu$, per zoosporas vel per tubum germinantibus; zoosporis ovoideis, apice obtusatis, basi rotundatis, $11-15 \times 6-9 \mu$, a latere biciliatis; oogoniis oosporisque ignotis.

Hab. in foliis Polygoni japonici Meisn.

[Spots on leaves at first yellowy-green then yellowish brown or brown, diffuse; intercellular hyphae, $5-15 \mu$ broad, conidiophores very slender, $4-20$ from the stomata, simple or sympodially branched below the sporangium, $15-75 \mu$ long, $1.5-5 \mu$ wide; sporangia oblong, or limoniform, varied in shape, apex with a conical papilla, $17-41 \times 4-20 \mu$, germinating by zoospores or a tube, zoospores ovoid, apex obtuse, base rounded, $11-15 \times 6-9 \mu$, laterally biciliate; oogonia and oospores unknown.

Hab. in leaves of Polygonum japonicum.]

[Latin diagnosis from S. Ito & Y. Tokunaga in Trans. Sapporo nat. Hist. Soc., 14, 1, p. 16, 1935.]

PHYTOPHTHORA PORRI Foister in Trans.bot.Soc.Edinb., 30, 4, pp. 277-278, figs. 1-3, 1931.

Mycelium ramosum, in juventate non-septatum, tandem multi-septatum atque vacuum, in regione sexuali in spiras contortum. Conidia inversi-pyriformia vel ovalia, $51 \times 35 \mu$ ($82-31 \times 52-23 \mu$), ad apices conidiophorum producta vel intercalaria, plerumque papilla deficiente, nunc papilla lata $5 \times 10-12 \mu$ nunc papilla rostrata $12 \times 10-12 \mu$ praedita; callositas apicalis hyalina $2.5-5.0 \mu$ nunc crassa; ostiolum latum; conidium ipsum in germinatione evolvit vel tubum vel zoosporidia $10-15 \mu$ quae iterato zoosporidia producant vel nunc tubum. Antheridia ovalia vel complanata sphaerica, terminalia vel intercalaria, in eadem hypha una cum oogonio haud inventa, aut amphigyna 12.5μ ($19.4-7.3 \mu$), aut paragyna $10-7.3 \mu$. Oogonium maturum sphaericum, muro inaequaliter incrassato munitum, $38-39 \mu$ ($46-29 \mu$), fecundum antheridio paragyno unico plerumque adjuvante, nunc pluribus, nunc antheridio amphigyno, nonnumquam ambobus eodem tempore. Oospora sphaerica, maturitate melleo-flava, $32-33 \mu$ ($39-22 \mu$), muro crasso $3-4.5 \mu$ cincta. Conidia in aqua atque in hospite abunde producta, in cultura solida infrequentia; genitalia in cultura solida vel liquida atque in hospite creberrima. In foliis caulibusque Allii Porri Linn. parasitica, ubi areolas aquosas, tandem albescentes praesertim ad apices foliorum inducit.

Hab. in ins. Britannicis.

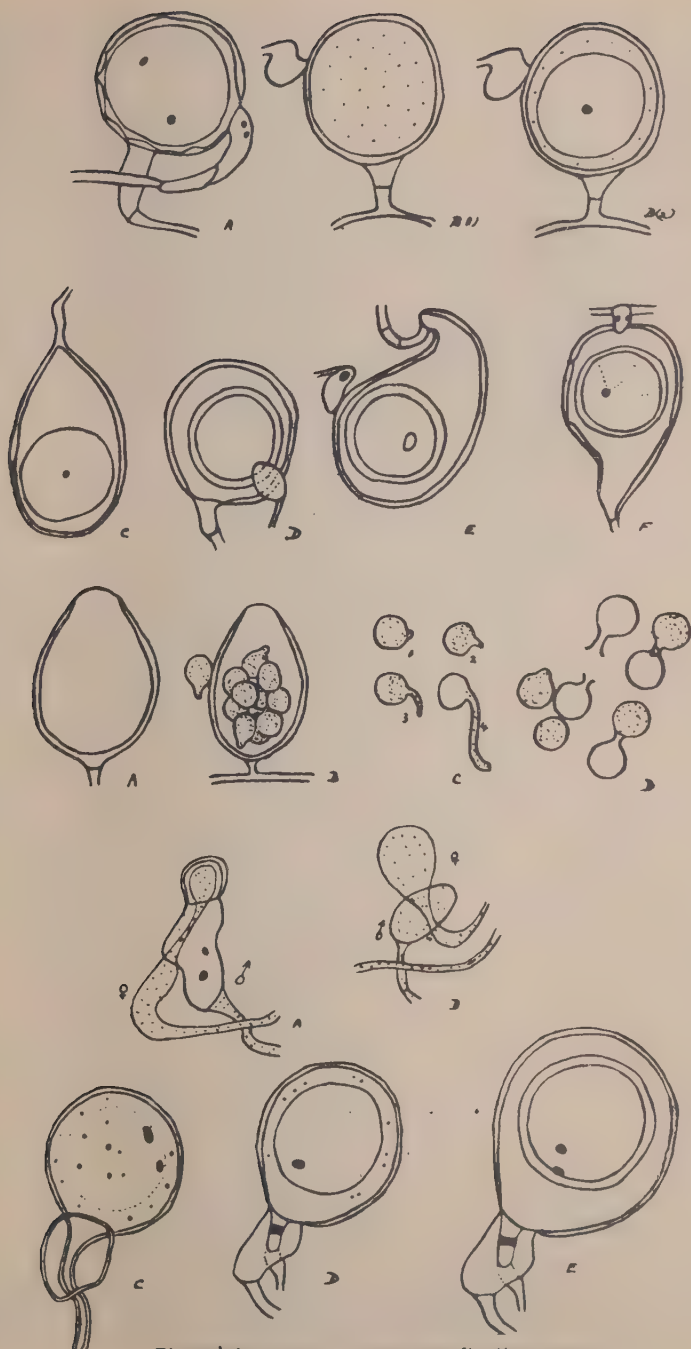
Mycelium branched, non-septate when young, septate and empty when old, coiled in spirals in region of sexual activity. Conidia inversely pyriform or oval, $51 \times 35 \mu$ ($82-31 \times 52-23 \mu$), produced at the end of conidiophores or intercalary, usually without a papilla, occasionally with a broad papilla $5 \times 10-12 \mu$, sometimes with a beaked papilla $12 \times 10-12 \mu$; apical thickening $2.5-5.0 \mu$ and hyaline, mouth of discharge broad, germination by a tube or by zoospores $10-15 \mu$, which may germinate in turn by zoospores (repetitional deplanetism) or by a germ tube. Antheridia oval or flattened spheres, terminal or intercalary, not on the same hypha as oogonium; when amphigynous 12.5μ ($19-7.3 \mu$), and when paragynous $10-7.3 \mu$. Mature oogonium spherical, with an unevenly thickened wall, $38-39 \mu$ ($46-29 \mu$), fertilised mostly by one paragynous antheridium, sometimes by several paragynous antheridia, sometimes by an amphigynous antheridium, and sometimes by both types at once. Oospore spherical, honey-yellow when old, $32-33 \mu$ ($39-22 \mu$), with a thick wall $3-4.5 \mu$. Conidia produced abundantly in water and in the host, less often in solid media; sexual organs formed abundantly in solid and liquid media in the host. Parasitic on the leaves and stems of Allium Porrum Linn., causing waterlogged areas followed by a whitening of the tips of leaves and other affected parts.

Hab. in British Isles.

PHYTOPHTHORA PRIMULAE Tomlinson in Trans.Brit.mycol.Soc., 35, 3, pl. 8, figs. 2, 3, 4, 5, p. 233, September 1952.

Hyphae hyalinae, primo continuae, demum septatae et vetustate protoplasmate vacuae, aliquando spiraler torsae. Sporangiophora non a mycelio distincta, $10-500 \mu$ longa. Sporangia terminalia, in forma et magnitudine variabilia; alia simplicia, ovoidea, obtuse ellipsoidea limoniformia vel obpyriformia, $33-165 \times 23-52 \mu$ (med. $77 \times 34 \mu$); alia elongata, multiplicia, e 2-11 partibus sphaericis vel irregularibus a septis vel obturaculis hyalinis divisis et catenatim conjunctis composita; vulgo non papillata vel papilla pertenu praedita, per zoosporas vel tubum germinantia. Sporangia secundaria aliquando nascentia, ita ut sympodium monochasiale productum est. Zoosporae $10-15 \mu$ diam. Antheridia et oogonia semper copiosa, et in textu radicis et in agare culta. Oogonia terminalia vel lateralia, globosa, $23-43 \mu$ (med. 37μ) diam. Antheridia terminalia, rarius intercalaria, diclina et paragyna, saepissime $14-18 \mu$ diam. Oosporae sphaericae, primo hyalinae, interdum vetustate lutescentes, $17-33 \mu$ (med. 30μ) diam. episporio laevi, 3μ crasso.

Hab. in radicibus Primulae polyanthae Mill., parasitica.



Phytophthora porri -- no magnification given

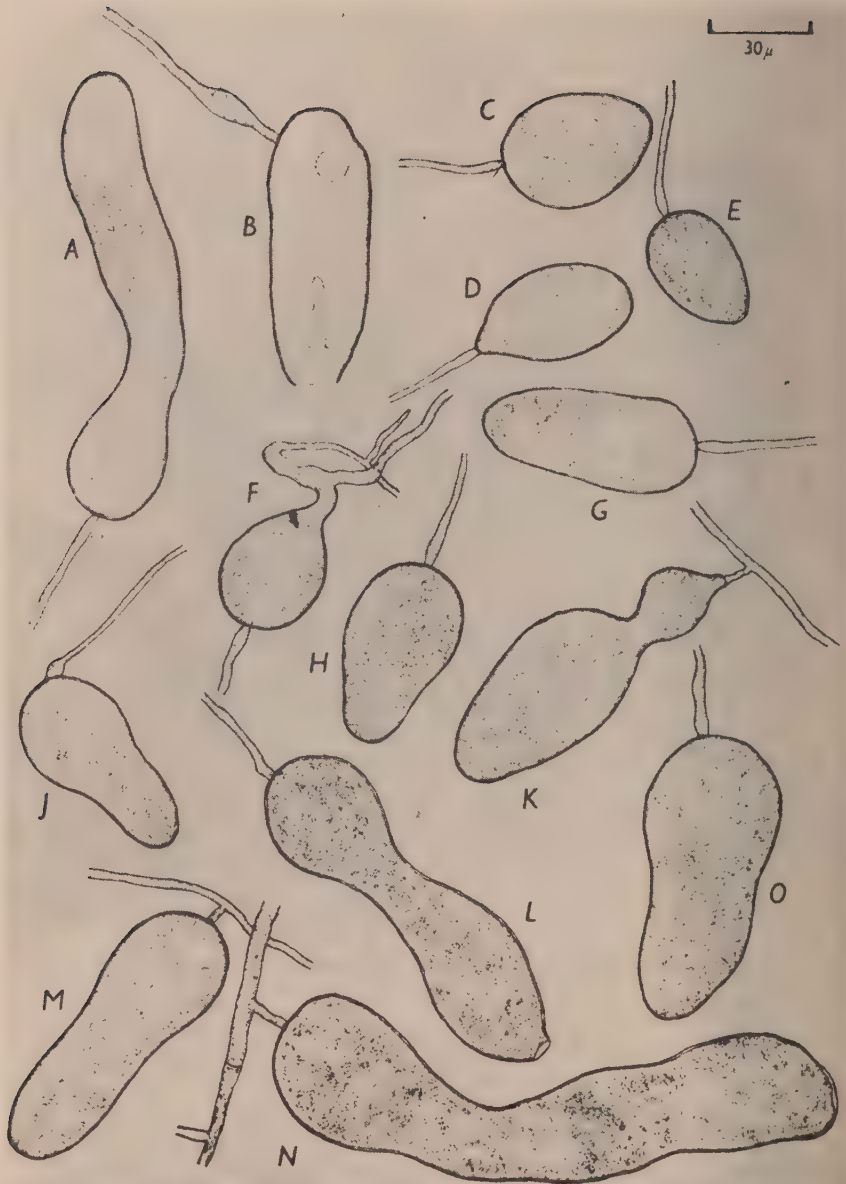


FIGURE 2

Phytophthora primulae

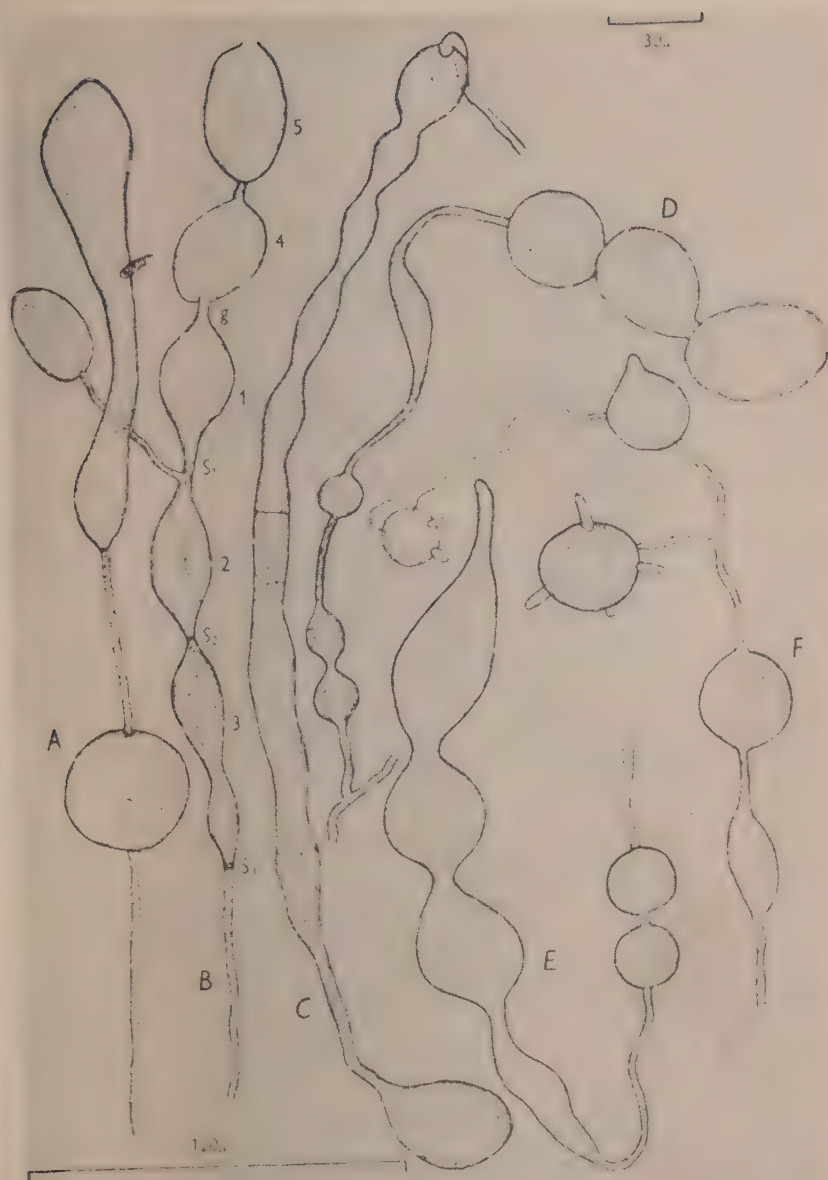


FIGURE 3

Phytophthora primulae

Mycelium hyaline, non-septate when young, septate and devoid of protoplasm when old; occasionally coiled in spirals. Sporangia terminal, developed on undifferentiated sporangiophores 10-500 μ long; in shape and size exhibiting great variation; some, single structures, ovoid, bluntly ellipsoid, limoniform or obpyriform, 33-165 $\times$ 23-52 μ (average 77 $\times$ 34 μ); others compound forms (compound sporangia), elongated structures consisting of two to eleven spherical or more irregularly shaped sporangial segments delimited at one or both ends by septa or hyaline plugs and connected in chain fashion, 100-351 $\times$ 6-36 μ ; generally non-papillate or with a shallow inconspicuous papillum germinating by zoospores or germ tubes. Zoospores 10-15 μ . Sporangia formed very occasionally with the development of a monochasial sympodium. Sexual organs formed abundantly in vascular tissue and in artificial culture. Oogonia terminal or lateral, globose, 23-43 μ (average 37 μ) in diameter. Antheridia terminal, rarely intercalary, declinuous and paragynous, mostly 14-18 μ in diameter. Oospores spherical, hyaline when young, sometimes light yellow when old, 17-33 μ (average 30 μ) in diameter, with a smooth wall 3 μ in thickness.

Habitat. In the roots of Primula polyantha Mill. causing a stele discoloration and root rot in England (Herbarium Plant Pathology Laboratory, Harpenden, Herts, No. 965, Type).

PHYTOPHTHORA QUININEA Crandall in Mycologia, 39, 2, p. 220, March-April 1947.

Hyphae primum continuae, maturae sparse septate, 3.7-8 μ in diam.; sporangia in aqua fluenti rivi abunde producta non-papillata, ovata usque obpyriformia, 45.9-67.5 $\times$ 25.5-37.5 μ (media 53.8 $\times$ 31.1 μ), rare e tubulis, plerumque e 14-20 zoosporis globosis 8-10 μ in diam. in aqua germinantia; sporangiophora in diam. minoria quam hyphae gerentes, apicem versus sub-attenuata, simplicia, usque 75 μ longa, sporangia singula terminalia gerentia, deinde basim sporangii evacuati penetrantia et sporangia nova gerentia; chlamydosporae terminales et intercalares, brunneae, sphaericae, 45-90 μ ; vesiculae abundantes, in forma et magnitudine irregulares; oogonia sub-sphaerica unque sphaerica, hyalina vel pallide flavidula, levia, 67.5-82.5 μ ; oosporae globosae hyalinae vel pallide flavidulae, granulosaе, 48.7-63.7 μ ; antheridia paragyna, in forma et magnitudine variabilia.

Hab. in radicibus et collaribus Cinchonae officinalis et C. pubescens, Peru.

Hyphal growth similar to that of other Phytophthoras, continuous when young, becoming sparsely septate with age, 3.7-8.0 μ , mostly approaching 8.0 μ , in diameter; vegetative growth luxuriant and cottonlike on oatmeal agar, aerial hyphae scarce and cobweb-like on cornmeal and potato dextrose agars, deep growing on and in the media, granular in appearance because of the early production of chlamydospores and vesicles; sporangia not observed on solid media but produced abundantly in running brook water, non-papillate, ovate to obpyriform, widest near the base, 45.9-67.5 $\times$ 25.5-37.5 μ (average of 30 mature sporangia 53.8 $\times$ 31.1 μ), germinating in water, rarely by germ tubes, regularly by discharge of 14-20 globose to ellipsoidal zoospores, 8-10 μ in diameter; sporangiophores smaller in diameter than the hyphae from which they arise but within limits of hyphal size tapering slightly toward the tip, simple, undifferentiated, up to 75 μ long, with single terminal sporangia, resuming growth through the base of the evacuated sporangium and producing new sporangia within or beyond the empty one; terminal and intercalary dark brown, spherical chlamydospores 45-90 μ , produced abundantly after 132 hours on cornmeal and oatmeal agars; vesicles abundant and irregular in size and shape, giving a thickened appearance to the hyphae and causing irregular growth; oogonia subspherical to spherical, hyaline to faint yellow, smooth, 67.5-82.5 μ ; oosporae spherical, hyaline to faint yellow, granular 48.7-63.7 μ ; antheridia paragynous, irregular in shape, variable in size; in the host mycelium penetrating inner bark, phloem, cambium, and outermost wood layers, inter- and intra-cellular. Causing a destructive root and collar rot of Ledger form Cinchona officinalis L. and C. pubescens Vahl in Peru.

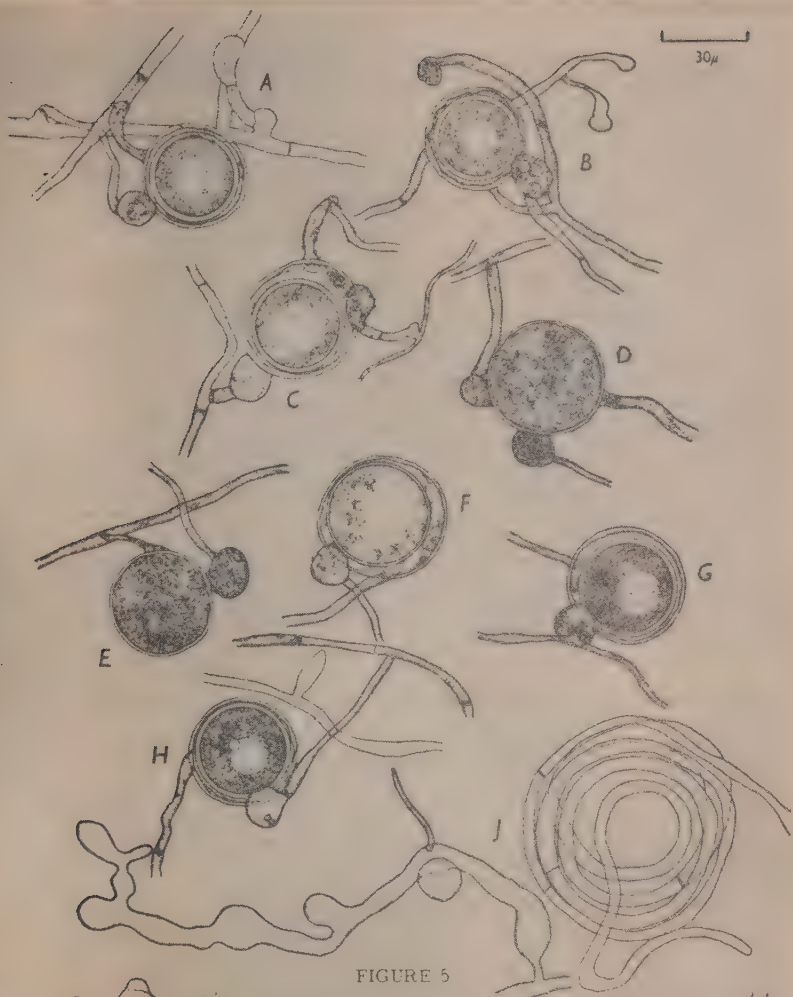
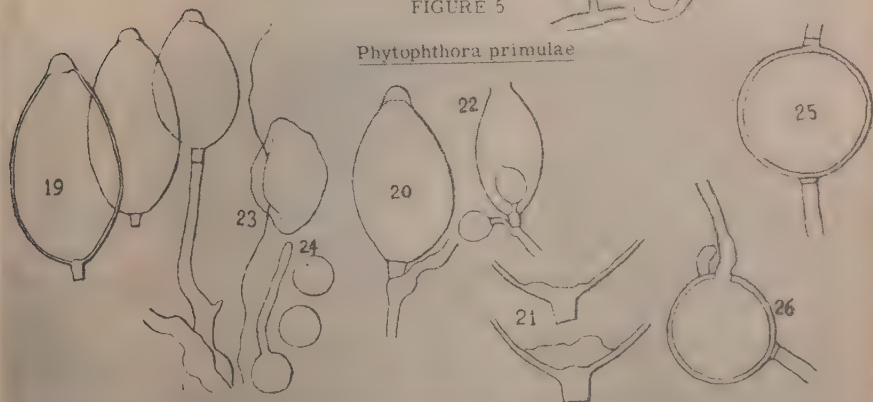


FIGURE 5

Phytophthora primulae*Phytophthora ricini* — figs. 19, 20, 22, 24-26, $\times 405$; 21, 23, $\times 940$

PHYTOPHTHORA RICHARDIAE Buisman in Tijdschr. PlZiekt., 33, 2, pp. 17-19, fig. 2, February 1927 [in Dutch]; Meded. phytopath. Lab. Scholten, 11, p. 19, Figs. 5-7, May 1927 [a more detailed version in English which was reprinted as Proefschrift Universiteit, Utrecht, Haarlem, 1927.]

Inderdaad is gebleken, dat wij hier met eene schimmelrotting van de wortels te maken hebben en wel door een zwam, die tot nog toe niet bekend was. Uitvoeringe mycologische bijzonderheden beschrijf ik later in mijn proefschrift. Ik moet haar als een tot nog toe onbeschreven soort kenmerken en noem haar dan Phytophthora richardiae n. sp.

.....
Bij het bezien van een rotte wortel door de microscoop, zag ik al spoedig in groote hoeveelheid sporangien, die zwermsporen vormden;.....

De vorming van de zwermsporen geschiedde in het sporangium en dus op de wijze, karakteristiek voor het geslacht Phytophthora.

Deze Phytophthora-achtige schimmel ontwikkelde zich geheel door de rotte wortel heen en vormde soms sporangien in groote hoeveelheid. Toen ik eenmaal deze Phytophthora kende zag ik haar ook op een zieke plant, die niet in water-cultuur had gestaan, maar zoo uit de aarde was genomen. Het gelukte nu ook, deze schimmel te isoleren. Zij is van het type der door Petri beschreven Phytophthora-achtige schimmel, die de inktziekte van de tamme kastanjes veroorzaakt (Blepharospora cambivora).

[In reality it was obvious that we had before us a mould rot of the roots, caused by a fungus hitherto unknown. Detailed mycological characteristics I shall give later in my thesis. I must designate it as a hitherto undescribed species and name it Phytophthora richardiae n. sp.]

.....
When looking at a rotted root through the microscope I saw a large number of sporangia forming swarm spores;.....

The formation of swarm spores took place in the sporangium and thus in the way characteristic of the genus Phytophthora.

This Phytophthora-like mould developed throughout the whole rotted root and formed now and then sporangia in large numbers. Having once come to know this Phytophthora, I saw it again on a diseased plant which had not been standing in water-culture, but had been taken thus out of the soil. Now the isolation of this mould was successful. It is of the type of Phytophthora-like mould described by Petri, which causes the ink-disease of the edible chestnut (Blepharospora cambivora).

Diagnosis from the later publication:

The mycelium is the same as that of other Phycomycetes. Sporangia vary in size as is apparent in the drawings. They are produced by the method of Petri, or by cultivating plants in water cultures and infecting the roots with the fungus. Zoospores reniform, biciliate, average $10\ \mu$ in size, produced in varying numbers in one sporangium. Oogonia produced in oatmeal-agar and in tissues of infected roots, obovate, growing through antheridium, diameter of distal end average $34-38\ \mu$. Oogonial wall yellow. Oospores average $29\ \mu$ in diameter, wall $2-2.5\ \mu$ in diameter and greenish purple in colour. Antheridia with protuberances, amphigynous, occurring on other hyphae than the oogonia.

Very virulent parasite of the roots of the Calla-lily causing them to decay. May also penetrate into the corms with the same effect.

PHYTOPHTHORA RICINI Sawada in Agric. Mag. Formosa, 38, 3, p. 173, 1942. [Japanese.]

Conidiophores, 1-3 from each stoma, have swollen bases and tapering tips and are $64-272 \times 3-4\ \mu$. Conidia ovate to narrowly ellipsoidal, papillate, $24-55 \times 17-33\ \mu$ averaging (20) $38.4 \times 25.45\ \mu$ with an l/d ratio of 1.556. There is a thick

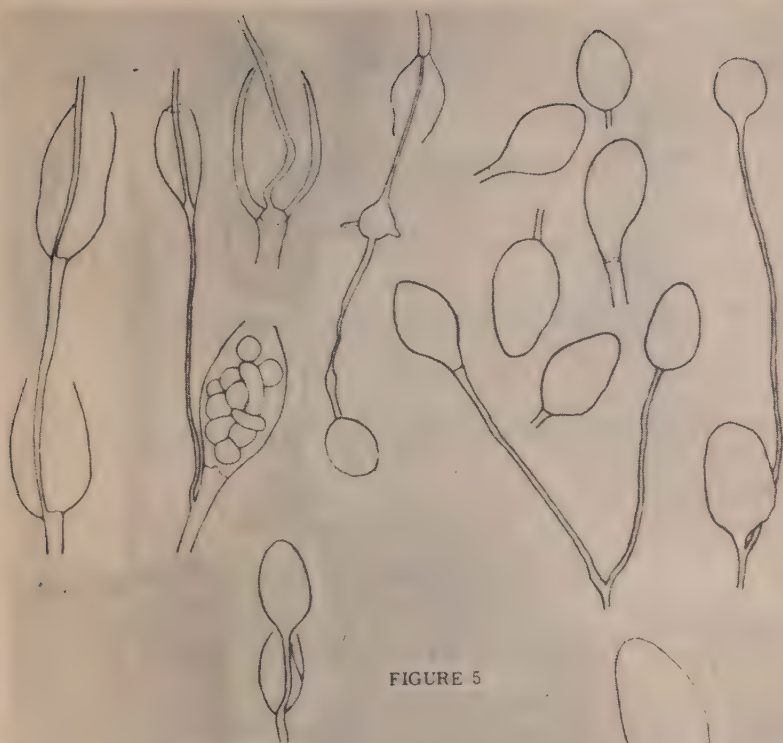


FIGURE 5

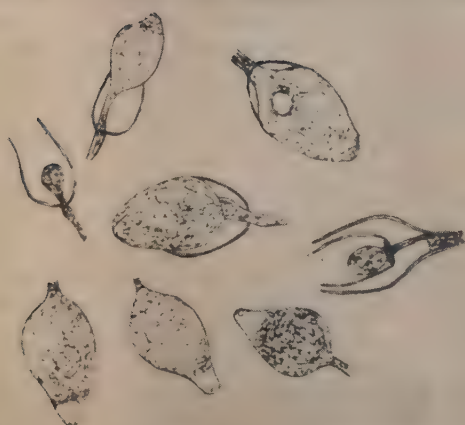


FIGURE 6



FIGURE 7

Phytophthora richardiae — figs. 5, 7, $\times \pm 366$; fig. 6, $\times \pm 400$

septum at the base of the conidium. Mycelium in culture 5-6 μ wide. Conidia produced sympodially. Conidia on other hosts 25-76 $\times$ 16-36 μ . Zoospores ovate, 12-15 $\times$ 9-10 μ , or 10-11 μ at rest. Chlamydospores numerous on ordinary media, globose, light yellowish brown, 14-56 μ diam. averaging on various media 31.55-40 μ , mode 35-41 μ . Oospores rare, found in bean decoction agar. Oogonium globose, hyaline, 26-32 μ in diam. oospores globose, hyaline, 24-26 μ in diam., antheridia amphigynous 15 $\times$ 12-15 μ .

On Ricinus communis parasitic on cotyledons and leaves. Taipeh, Formosa, 23.10.1923.

[From a translation by Dr. C. T. Wei of a reprint of the original in Rep. Gov. agric. res. Inst., Formosa, 85, 1943. Figures in the same publication pl. I figs. 19-26. No Latin diagnosis.]

PHYTOPHTHORA SABDARIFFAE Thung in Tijdschr. Plziekt., 53, 3, p. 86, 1947.

Nomen nudum.

PHYTOPHTHORA SPECIOSA Mehlisch in Blumen- u. PflBau ver. Gartenwelt, 39, 19, p. 228, May 1935.

Da dieser Falsche Mehltau noch nicht genau erforscht ist, hat er den namen Phytophthora speciosa erhalten.

[Because this downy mildew is not yet precisely investigated it has received the name Phytophthora speciosa.] [?Phytophthora species.]

PHYTOPHTHORA STELLATA Shanor in J. Elisha Mitchell sci. Soc., 54, 1, p. 155, pls. 15, 16, June 1938.

Growth delicate on Rhododendron petals and on hemp seed in water, quite dense and often reaching out to a length of 1-2 cm. or more. Threads of the mycelium 3.5-7.0 μ thick, mostly about 5.6 μ , very rarely septate; septa, when present, found near reproductive branches or in old cultures. Walls giving a cellulose reaction with chloriodide of zinc. Sporangia borne either terminally or on short branches lateral, usually somewhat obpyriform, sometimes more oval or more elongated; if terminal measuring from 80.6-115.8 μ long by 36 μ wide, mostly about 44.25 $\times$ 26.9 μ . Zoospore formation and sporangial development are of the P. palmivora type and a vesicle is usually formed at the end of an exit tube. Zoospores biciliate, spherical to reniform and measuring 10.3 to 14.4 μ when resting. Oogonia borne on short side branches, spherical, 15.5-22.4 μ in diameter, occasionally up to 30 μ , with sharp spines of various lengths, measuring up to 3.6 μ long. Eggs single, almost filling the oogonium, measuring 13.8 μ to 17.2 μ , mostly about 14.3 μ to 15.5 μ . The walls of the young oogonia present a yellowish brown colour, becoming more hyaline at maturity. Mature eggs have a single large eccentric oil globule. Antheridial branches arise either from the same or adjoining hyphae to the oogonium, but most often arise only a short distance below the oogonium. Antheridia single, club-shaped, much larger than the antheridial branch, 7.0-10.4 μ thick. The antheridium is most frequently attached near the stalk. Because of its position the oogonium often appears to have grown up through the antheridium. The contents of the antheridium are emptied into the oogonium and antheridia attached to mature eggs are entirely empty.

Collected once on petals of Rhododendron maximum which had fallen into a cold spring in front of Mr. Mell's cabin near Highlands, North Carolina, in August, 1937.

[No Latin diagnosis.]

PHYTOPHTHORA SYMMETRICA Sideris

This name appeared first in the 1930 List of Cultures of the Centraalbureau

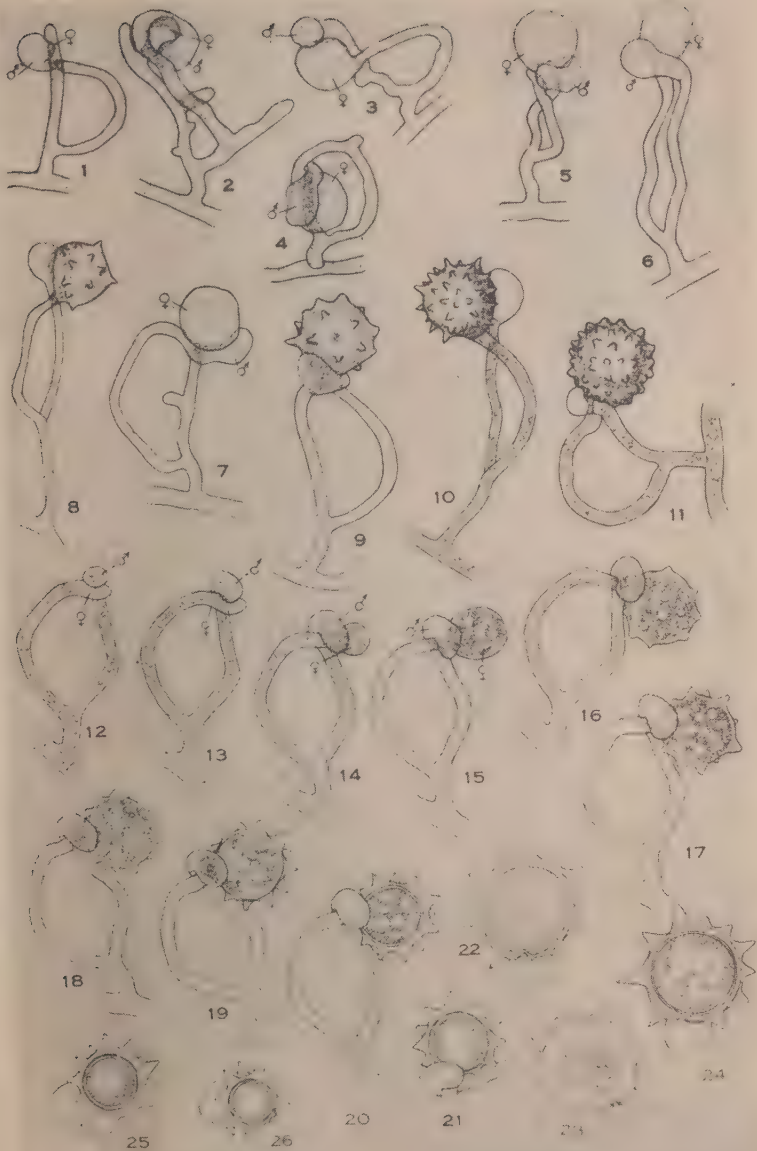


PLATE 15

Phytophthora stellata — pl. 15, figs. 1-21, 25-26, $\times 505$; 22-24, $\times 830$; pl. 16, fig. 27, $\times 83$; 28-33, 35, 39, $\times 367$; 34, $\times 175$; 36-38, no magnification given

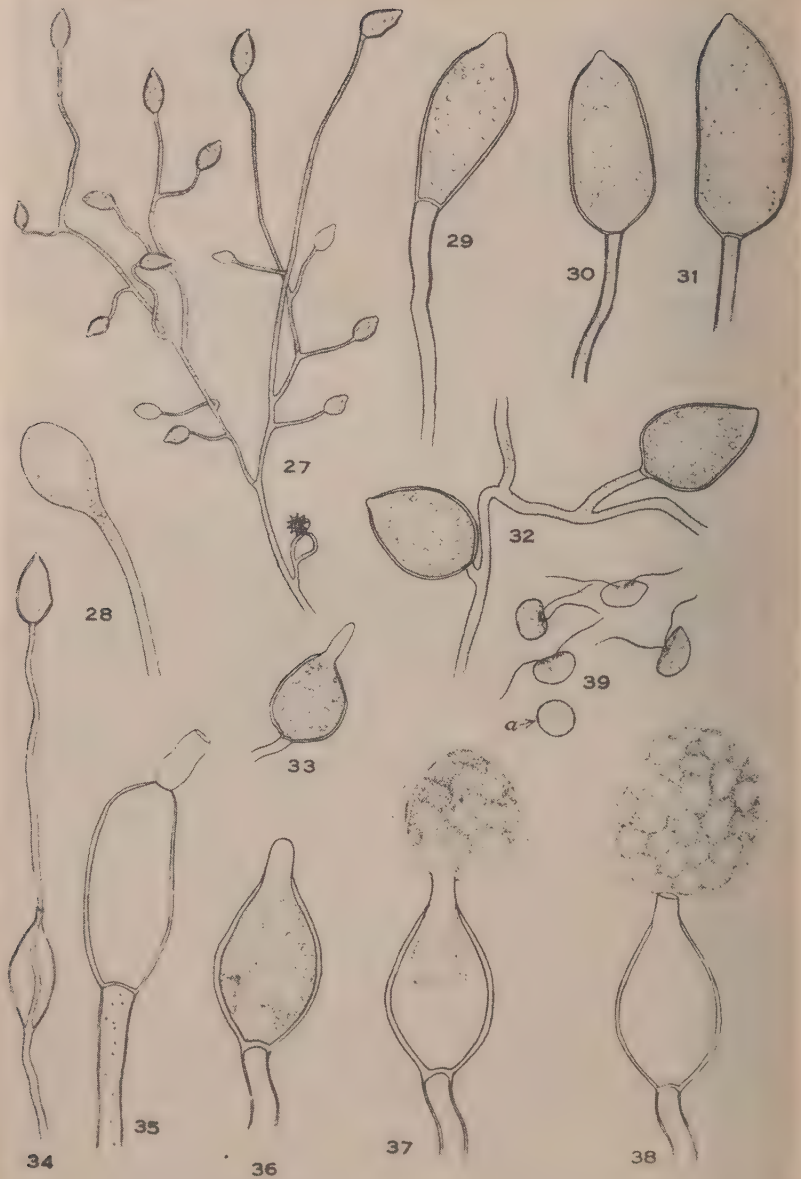


PLATE 16

Phytophthora stellata

voor Schimmelcultures, Baarn, Holland. No published description has been found.

PHLOEOPHTHORA SYRINGAE Klebahn in Zbl. Bakt., Abt. 2, 15, 10-11, pp. 335-336, [?May] 1906.

In den Interzellularräumen der kranken Rinde findet sich ein Pilz, dessen dicke, plasmareiche, mit spärlichen aber charakteristischen Querwänden versehene Hyphen bis an die Grenzen der Braunfärbung vordringen. Die Pilz bildet Dauersporen, im Gewebe der Rinde in den Interzellularen, in den Knospen auch zwischen den Blatt- und Blütenanlagen. Die Sporen sind rund oder oval, 18-28 μ dick und haben eine dicke, glatte, farblose oder schwach gelbliche Membran. Sie liegen innerhalb einer zweiten, zarten, meist etwas abstehenden Membran, welcher aussen eine kleinere, leere Zellen flach ansitzt. Diese Strukturen erinnern an die Oosporen, Oogonien, und Antheridien der Peronosporaceen. Peronospora-artige Konidienträger wurden jedoch nicht gefunden.

Die vorliegenden Erfahrungen weisen dem Pilze seinen Platz in der Verwandtschaft der Peronosporaceen an. Ich schlage vor, den Pilz als *Phloeophthora Syringae* zu bezeichnen (von $\phi\lambda\omicron\iota\omicron\varsigma$ Baumrinde und $\phi\theta\omicron\rho\rho\acute{\alpha}$ Verderben).

[In the intercellular spaces of the diseased bark is found a fungus with thick, plasma-filled hyphae provided with sparse, but characteristic cross walls, advancing as far as the limit of the brown colour. The fungus forms resting spores in the tissue of the bark in the intercellular spaces, also in the buds between the leaf and flower initials. The spores are round or oval, 18-28 μ wide and have a thick, smooth, colourless or slightly yellowish wall. They lie inside a double, thin, somewhat loose wall which bears outside a smaller, empty flat cell. These structures are reminiscent of the oospores, oogonia, and antheridia of the Peronosporaceae. Peronospora-like conidia were not, however, found.

The foregoing experiences point to the place of the fungus in relationship with the Peronosporaceae. I propose to designate the fungus as *Phloeophthora syringae* (from $\phi\lambda\omicron\iota\omicron\varsigma$ tree bark and $\phi\theta\omicron\rho\rho\acute{\alpha}$ destruction).

PHYTOPHTHORA SYRINGAE (Klebahn) Klebahn, Krankheiten des Flieders, Gebrüder Borntraeger, Berlin, p. 75, figs. 27, 32, 33, 35, 36, [?August] 1909.

≡ *Phloeophthora syringae* Klebahn [q. v.]

≡ *Nozemia syringae* (Klebahn) Pethybridge [see above, under Nozemia]

≡ *Phytophthora cactorum* subvar. *syringae* (Klebahn) Sarejanni [q. v.]

Mycel intercellular, vielfach verzweigt, einzellig, in älteren Zuständen oft mit gewölbten, querwandähnlichen Bildungen, die der Protoplasmaabewegung kein Hindernis bereiten, bei der Fruktifikation aber häufiger werden und dann der Abgrenzung leerer und plasmaerfüllter Hyphenstrecken dienen. Fadenförmige Haustorien in die Wirtszellen eindringend. Sporangien eiförmig, verkehrt eiförmig oder ellipsoidisch, 40-75:30-42 μ , nur im Wasser entstehend, einzeln endständig an dünnen Fäden oder zu mehreren (bis 7) in sympodial entwickelten Sporangienständen vereinigt, am Ende mit einem flachen Deckel, der bei der Entleerung verquillt und eine weite, abgestutzte Öffnung zurücklässt. Sporangienwand nach der Entleerung gerunzelt. Inhalt schon vor dem Ausschlüpfen zerklüftet, in der Regel während des Ausschlüpfens, seltener gleich nach demselben in Schwärmsporen zerfallend. Diese eiförmig, 9 11:8-9 μ , etwas unsymmetrisch, seitlich mit 2 Geisseln, von denen die kürzere (16-18 μ) vorwärts, die längere (23-30 μ) rückwärts gerichtet ist, lange schwärmend. Oogonien im Gewebe der Nährpflanze oder im Innern des festen Substrats entstehend, selten und ausnahmsweise an Luftmycel, endständig oder interkalar, am Grunde nicht in einen Stiel verjüngt. Antheridien an Seitenhyphen, einzeln oder zu mehreren, angeschwollen, an unbestimmten Stellen mit breiter Fläche dem Oogonium sich anlegend. Oosporen einzeln im Oogonium entstehend, dasselbe fast ganz ausfüllend, meist

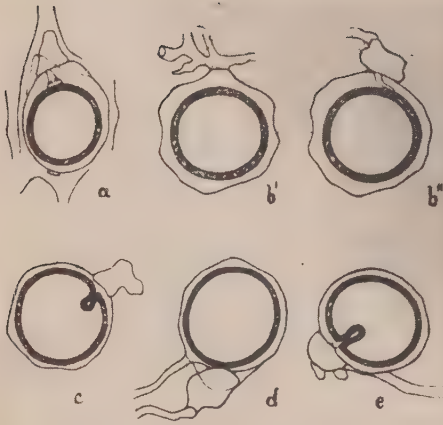


FIGURE 27

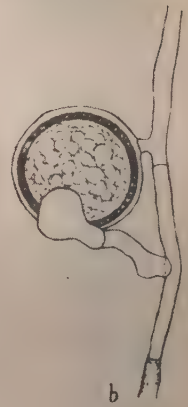
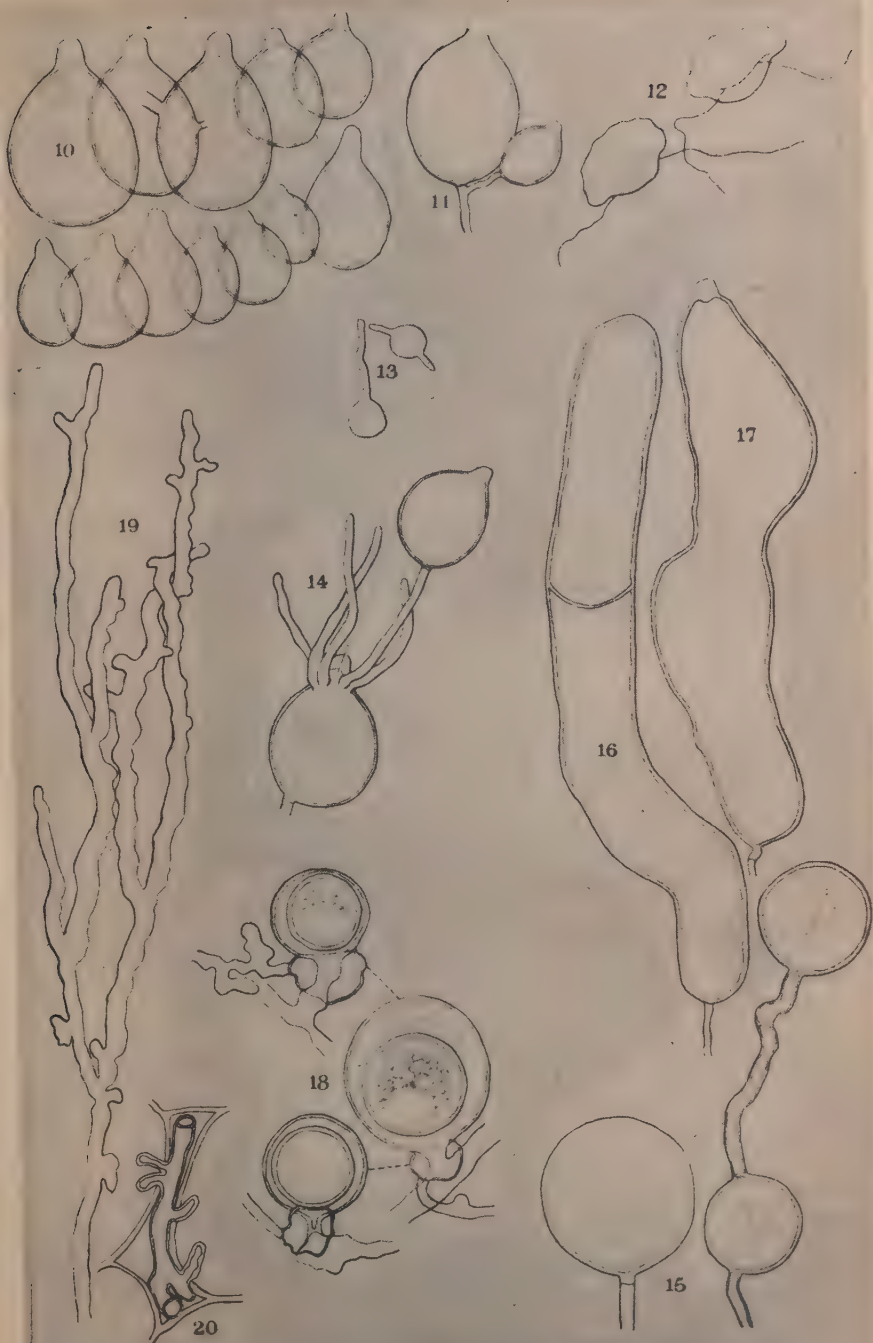


FIGURE 32



FIGURE 35

Phytophthora syringae — fig. 27, $\times 549$; 32, $\times 1,050$; 35, a, $\times 236$; b, c, $\times 192$



Phytophthora tabaci — all figs. except 12, $\times 405$; 12, $\times 940$

rund, seltener oval, 18-36:17-25 μ . Membran dick, gelblich, glatt.

[Mycelium intercellular, many times branched, unicellular in the older parts often with arched, cross-wall-like structures, which afford no hindrance to the movement of protoplasm, but frequently grow near the fructification and then serve as the boundary of the empty and plasma-filled stretches of hyphae. Thread-like haustoria penetrate into the host cells. Sporangia ovoid, obovoid or ellipsoidal, 40-75:30-42 μ , only developing in water, single terminal on thin threads, or more (up to 7) together on sympodially developed sporangiophores with a flat cap at the end, which bursts out in the emptying and leaves a wide truncated opening. The contents already cleaved before slipping out, as a rule during the emission, seldom breaking up at once by themselves into swarm spores. These are ovoid, 9-11:8-9 μ , somewhat asymmetrical, with two lateral flagella, one of them shorter (16-18 μ) directed forwards, the longer (23-30 μ) backwards, swarming for a long time. Oogonia developing in the tissue of the host plant or in the interior of the solid substratum, seldom and exceptionally on the aerial mycelium, terminal or intercalary, at the base not tapering to a stalk. Antheridia on lateral hyphae, single or more, swollen, on undefined places, with the broader surface applied to the oogonium. Oospores developing singly in the oogonium, filling the same almost completely, mostly round, seldom oval, 18-36:17-25 μ . Wall thick, yellowish, smooth.]

PHYTOPHTHORA TABACI Sawada in Rep. Govt. Res. Inst., Formosa, 27, pp. 37-38, pl. III (figs. 10-20), September 1927. [Japanese]

Maculis in foliis caulibusque, rotundatis, olivaceis dein brunneis; hyphis intercellularibus, 7-8 μ latis, haustriis cylindraceis instructis; sporangiis ovoideis, ellipsoideis vel globoso-ovoides, apice papilla distincta ornatis, 16-58 $\times$ 12-45 μ , interdum 74 $\times$ 64 μ , per zoosporas vel per tubum germinantibus; zoosporis ovoideis, a latere biciliatis, 13 $\times$ 8-9 μ ; chlamydosporis flavo-brunneis, sphaericis, 21-55 μ diam. [average in the original paper 36:6 μ], membrana 1:5-2 μ crassa; oogoniis sphaericis, hyalinis, 26-30 μ [average in the original paper 28:13 μ] vel raro 43 μ diam., membrana levi; antheridiis amphigenis, obovodeis vel sphaericis, 14-18 $\times$ 11-18 μ ; oosporis sphaericis, hyalinis, 21-24 μ vel raro 30 μ diam., episporio levi, tenuiusculo tectis.

Hab. in foliis caulibusque Nicotianae tabaci L.

This species is closely related to P. parasitica Dastur, and it may be a biological species of the latter.

[Round spots on leaves and stalks, olive then brown; intercellular hyphae 7-8 μ wide with cylindrical haustoria; sporangia ovoid, ellipsoid, or globose-ovoid, distinct papilla at the apex, 16-58 $\times$ 12-45 μ , sometimes 74 $\times$ 64 μ , germinating by zoospores or tube; ovoid zoospores laterally biciliate, 13 $\times$ 8-9 μ ; chlamydosporis golden-brown, spherical, 21-55 μ in diameter, wall 1:5-2 μ thick; oogonia round, hyaline, 26-30 μ or sometimes 43 μ in diameter, wall smooth; antheridia amphigynous, obovoid, or round, 14-18 $\times$ 11-18 μ ; oospores round, hyaline, 21-24 μ or sometimes 30 μ in diameter, episporium smooth, wall very thin.

Hab. on stems and leaves of Nicotiana tabacum L.]

[Latin diagnosis given by S. Ito & Y. Tokunaga in Trans. Sapporo nat. Hist. Soc., 14, 1, p. 16, 1935.]

PHYTOPHTHORA TERRESTRIS Sherbakoff (as P. terrestria) in Phytopathology, 7, p. 127, figs. 4, 5, April 1917.

Blépharospora terrestris (Sherbakoff) Peyronel in R. C. Accad. Lincei, Ser. 5, 29, 4, pp. 194-196, 7th March 1920. He says

... le osservazioni sin qui eseguite già permettono di stabilire l'identità del fungo in questione con la Phytophthora terrestris Sherbakoff. ...



FIGURE 4



FIGURE 5.

Phytophthora terrestris — fig. 4. $\times 1,240$; fig. 5A $\times 100$; B-L, $\times 500$

È evidente, ad ogni modo, che la specie de Sherbakoff presenta tutti i caratteri de genere *Blepharospora*, quale è definito, per quanto un po' vagamente, dal Petri. Il nome specifico *terrestria*, poi, è di un latino un po' troppo americano, e va corretto. Propongo pertanto di dare al fungo il nome di *Blepharospora terrestris* (Sherbakoff) Peyronel.

[. . . . the observations which have been made up to the present enable me to establish the identity of the fungus in question as *Phytophthora terrestris* Sherbakoff.]

It is evident, in every way, that the species of Sherbakoff presents all the characters of the genus *Blepharospora* which was defined, though a little vaguely, by Petri. The specific name *terrestria*, however, is in somewhat American Latin, and is corrected. I propose, therefore, to give the fungus the name *Blepharospora terrestris* (Sherbakoff) Peyronel.]

Mycelio pruio continuo deinde septato; conidiis fere terminalibus aliquando intercalariis, plerumque ovoideis apice papillatis sed valde variabilibus, 42.5×30.5 ($36-46 \times 24-35$) μ , per zoosporos fere germinatis; zoosporis asymmetris, lateraliter 2-ciliatis, 9.5 ($9-11$) μ diam. quum quieti, globosi statu; chlamydosporis vulgaribus, plerumque globosis, 34 ($30-40$) μ diam.; oogoniis globosis, 22 ($19-24$) μ diam., radicibus per amplum sub-globosum antheridium aperte penetrantibus; oosporis globosis 20 ($18-21$) μ diam.; coloniis in agarò Zeae Maydis farina, in petri patera, suo genere cristati.

Hab. parasitice in fructibus Lycopersici esculente efficiens 'buck-eye rot', in truncis Citri efficiens 'foot rot', in caulibus Lupini sp. efficiens 'stem rot', et aperte in humilibus solis, Floridensibus, Am. bor.

Mycelium at first continuous then septate; conidia usually terminal, sometimes intercalary, mostly oval, papillate at apex but variable, 42.5×30.5 ($36-46 \times 24-35$) μ , germinating mostly by swarm-spores; swarm-spores asymmetric, with two cilia on one side, 9.5 ($9-11$) μ when in resting, globoid stage; chlamydospores common, mostly globose, 34 ($30-40$) μ ; oogonia common in old cultures on steamed bean pods, globose, 22 ($19-24$) μ with the stalk evidently penetrating through large, nearly globose antheridium; oospores globose, 20 ($18-21$) μ ; colonies on corn-meal agar, in petri dish, peculiarly tufted.

Hab. Parasitic in tomato fruit causing buckeye rot, in bark of trunks of citrus trees causing foot rot, in stems of a Lupine causing stem rot, and apparently in low soils; in Florida.

PHYTOPHTHORA TERRESTRIS var. RHEI

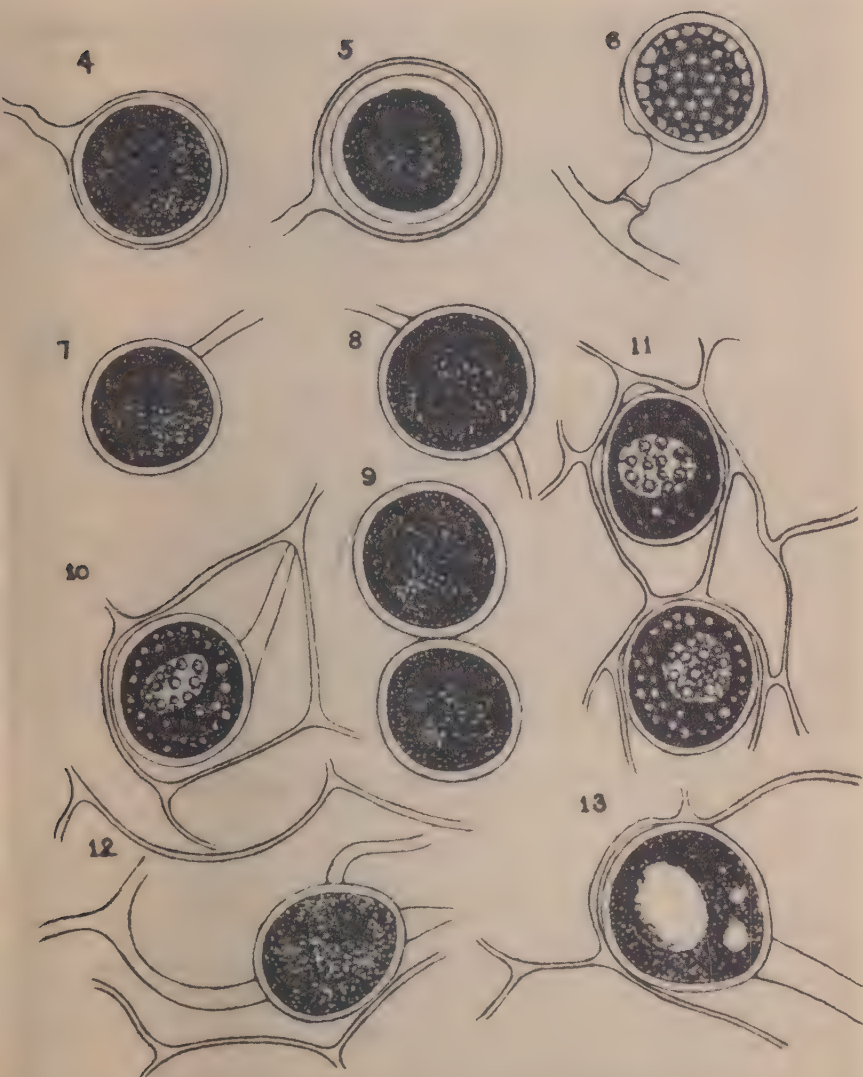
This name appears only in a list of cultures received by C. M. Tucker as the name of a culture sent by C. Drechsler, isolated from rhubarb. See *Res. Bull. Mo. agric. Exp. Sta.* 153, p. 170, June 1931.

PHYTOPHTHORA THALICTRI Wilson & Davis in *Bull. Torrey bot. Cl.*, 34, p. 392, August 1907.

Hypophyllous, the infested area suborbicular or irregular in outline, appearing somewhat glaucous; epiphyllous discoloration very dark, almost black, sometimes with a distinct brownish margin; conidiophores fasciculate from the stomata, continuous, lax and somewhat flexuose, rather scattered on the infested area and not forming a dense felt, $300-400 \times 5-7$ μ , bearing usually 1 or 2 branches, sub-conidial swellings narrowly conical, less than twice as thick as the branch; conidia elliptic, apically papillate, $20-27 \times 13-17$ μ ; oospores unknown.

Type collected by Dr. J. J. Davis, June 20, 1907, in Kenosha County, Wisconsin, on *Thalictrum purpurascens* L. Specimens in his herbarium and in Dr. Wilson's.

Distinguished from *P. infestans* by the more pronounced discoloration of the



Phytophthora theobromae — figs. 4-13, $\times 850$

infested area and the less disastrous effect on the host; the shorter and more slender conidiophores which form a sparse covering to the infested area instead of forming a dense felt as in other American species, and which are more persistent than is common in the genus; the slightly smaller and more elongate conidia.

G. P. Clinton in Rep. Conn. Agric. Expt. Sta. 1908, p. 894, July 1909 found the conidiophores varying from $250-500\ \mu$, and one with three branches, each bearing one to three conidial swellings.

The oospores were formed only rarely and in moderation in a few of the leaves found at the very end of the season.

They seemed to have an oogonial wall somewhat more deeply tinted than those of *P. phaseoli*. So far as could be determined, the antheridia and oogonia were developed from different mycelial threads. The oogonia are chiefly subspherical, with moderately thin, reddish-brown tinted walls, loosely enveloping the oospore, and $25-33\ \mu$ in diameter. The oospores are spherical, hyaline or slightly yellowish tinted, with medium thick and smooth wall ($3-4\ \mu$) and varying from $18:5$ to $25\ \mu$ in diameter.

PHYTOPHTHORA THEOBROMAE Coleman in Bull. Agric. Mysore, Mycol. Ser., 2, p. 86, pl. 18 (figs. 4-13), October 1910.

Mycelium richly branched both inter- and intracellular, unseptate in the earlier stages of growth, but later forming septa which frequently serve to separate off empty and dead portions of the mycelium. Haustoria not observed. Sporangia generally ovate but somewhat variable in shape. Extreme measurements as given by von Faber are $25 \times 30\ \mu$ and $42 \times 80\ \mu$. Sporangioophores in water cultures sympodially branched as in *P. Faberi* and bearing up to 20 sporangia or more. Oogonia formed intramatrically in the host plant as well as in artificial cultures on agar and sterilised potato. Antheridia absent or if at all present only rarely formed. Oospores entirely or for the most part formed parthogenetically, practically filling the oogonial cavity, in artificial cultures spherical, in the host tissue spherical, elongate or irregular, $22\ \mu$ to $45\ \mu$ in diameter. Found as a parasite on fruits of *Theobroma Cacao*, and also upon fruits of *Hevea brasiliensis* and *Artocarpus incisa* according to Petch. Found capable of infecting a number of the host plants of *P. omnivora* and in addition seedlings of *Lycopersicum esculentum*.

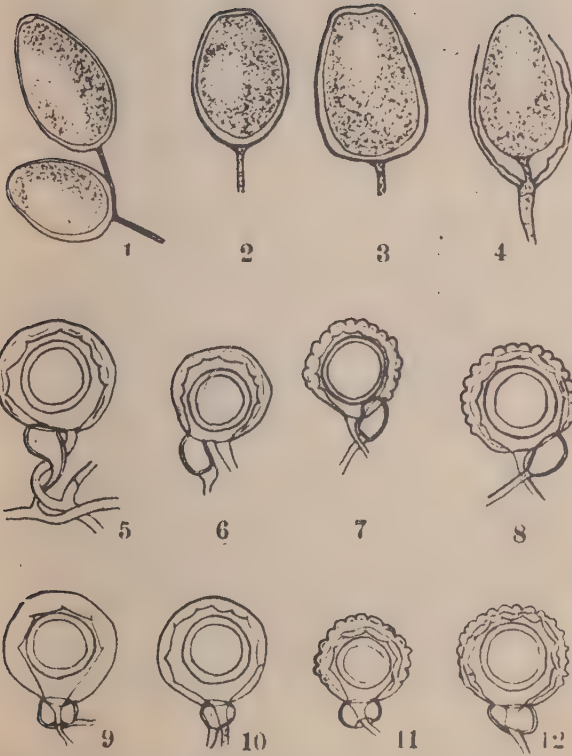
According to Busse (loc. cit.) this fungus also attacks the bark of Cacao trees.

PHYTOPHTHORA VERRUCOSA Alcock and Foister in Trans. bot. Soc. Edinb., 33, 1, pp. 65-66, figs. 1-12, 1940.

Mycelium ramosum, in juventate non septatum tandem leviter septatum atque vacuum. Sporangia $41.5 \times 29.5\ \mu$ ($31-56 \times 24-36\ \mu$), inversi-pyriformia vel ovalia, acrogena vel pleurogena, papillis et pediculi deficientibus apice late rotundata et leviter incrassata; germinatio per zoosporas. Sporangioophora per zoosporangia evacuata penetrantia et zoosporangia nova gignentia. Oogonia acrogena vel rarius intercalaria, sphaerica, $37\ \mu$ ($23-47\ \mu$), crasse tunicata ($4.7\ \mu$), membrana externa verrucosa vel rarius leve. Antheridia acrogena vel rarius intercalaria, paragyna, $16 \times 13\ \mu$ ($11-22 \times 10-17\ \mu$), vel amphigyna, $17 \times 5\ \mu$ ($9-22 \times 8-20\ \mu$). Oosporae sphaericae, maturitate melleoflava, $24\ \mu$ ($17-31\ \mu$), hyalinae, membrana leve $3\ \mu$ crassa.

Hab. in radicibus *Lycopersici esculenti* et *Meconopsis* spp. in ins. Brittanica.

Mycelium branched, non-septate when young, slightly septate and empty when old. Sporangia $41.5 \times 29.5\ \mu$ ($31-56 \times 24-36\ \mu$), inversely pyriform or oval, terminal or lateral, on undifferentiated sporangioophores 15 to $250\ \mu$ long, non-paillate with broadly rounded, slightly thickened, hyaline apex, no pedicel, germinating by zoospores, mouth of discharge broad. Further sporangia produced commonly within and rarely beyond an empty one by renewed sporangioophore growth. Sexual organs developed in or more commonly on surface of cortical tissues. Oogonia terminal, rarely lateral, spherical, $37\ \mu$ ($23-47\ \mu$), usually



Phytophthora verrucosa — no magnification given

with very thick wall $4.7\ \mu$ ($1.7-7.7\ \mu$), internally unevenly thickened, collapsing when thin-walled, outer wall predominatingly verrucose, sometimes smooth. Antheridia paragynous $16 \times 13\ \mu$ ($11-22 \times 10-17\ \mu$) or amphigynous $17 \times 15\ \mu$ ($9-22 \times 8-20\ \mu$), commonly terminal, rarely lateral. Oospores spherical, light golden brown with age, usually lying free within oogonium, $24\ \mu$ ($17-31\ \mu$), hyaline with smooth $3\ \mu$ -thick wall. Parasitic on roots of cultivated Tomato and Meconopsis spp.

NAMES NOT TAKEN INTO PHYTOPHTHORA

BLEPHAROSPORA AURANTII Peyronel quoted by Dufrénoy in Ann. Inst. Rech. Agron. (Ann. Épiphyt.), 11, p. 466, 1925.

The citation of Peyronel cannot be traced.

BOTRYTIS FALLAX Desmazières, Cryptogams de France i, 1492, 1845.

[Usually given as a synonym of Phytophthora infestans.]

BOTRYTIS SOLANI Harting in Ann. Sci. Nat., Ser. 3 (Bot.), 6, p. 44, 1846.

[Usually given as a synonym of Phytophthora infestans.]

Les moisissures que j'ai rencontrées appartenaient toujours à l'espèce observée dans les autres provinces de la Néerlande, et, à en juger d'après les descriptions publiées, elle est aussi identique avec celle qu'on a vue se développer sur les feuilles de pommes de terre malades sur différents points de la Belgique et de la France. Cette Mucedinée a déjà reçu plusieurs noms. Mais, comme ces noms indiquent d'une manière plus ou moins implicite l'opinion qui considère la Mucedinée comme la cause de la maladie, j'ai choisi un nom qui, sous ce rapport, ne préjuge rien, et j'ai adopté celui de Botrytis solani.

[The moulds which I have encountered all belong to the species seen in other provinces of the Netherlands and, to judge by the published descriptions, it is also identical with that seen to develop on diseased potato leaves in different parts of Belgium and France. This member of the Mucedineae has received many names. But as these names indicate, in a manner more or less implicit, the opinion which supposes the member of the Mucedineae to be the cause of the disease, I have chosen a name which, in this connection, assumes nothing, and I have adopted that of Botrytis solani.]

MYCELOPHAGUS CASTANEA Mangin in C.R. Acad. Sci., Paris, 136, pp. 471-472, 16 February 1903.

Le parasite est un champignon à mycélium délicat... à cause de la présence de la cellulose dans sa membrane... Son mycélium est constitué par de très fins filaments ayant $1\ \mu$ à $2\ \mu$ de diamètre, parfois renflés en certains points et atteignant $3\ \mu$ à $4\ \mu$; il est très irrégulièrement cloisonné.

.....

Les fructifications se présentent sous l'aspect de masses renflées plus ou moins régulièrement, à l'extrémité de rameaux latéraux et ayant $6\ \mu$ à $8\ \mu$ de large; ce sont là des formes jeunes. Dans d'autres rhizomorphes, les fructifications ont l'aspect de vésicules à parois minces, terminant toujours des rameaux, et ayant $20\ \mu$ de diamètre et renfermant une spore sphérique à membrane tanto mince, tantôt très épaisse, ayant toutes les réactions de la callose. Sous cette forme, les fructifications sont identiques aux oospores des Péronosporées.

Ainsi défini par son mycélium cellulosique très délicat, qui rappelle celui des Mucorinées, par ses fructifications semblables à celles des Péronosporées, le parasite qui détruit les mycorrhizes des Chataigniers me paraît constituer un genre nouveau dans le groupe des Oomycètes; je le désignerai sous le nom de Mycelophagus castaneae (Mangin).

[The parasite is a fungus with a delicate mycelium. because of the presence of cellulose in the wall. . . . Its mycelium is made up of a very fine hyphae $1\ \mu$ to $2\ \mu$ in diameter, sometimes swollen at certain points and attaining 3 to $4\ \mu$; it is very irregularly septate.

.

The fructifications appear as masses swollen more or less regularly at the ends of lateral branches and being 6 to $8\ \mu$ wide; these are the young forms. In other rhizomorphs, the fructifications have the appearance of vesicles with thin walls, always terminating a branch, and being $20\ \mu$ in diameter and containing a spherical spore with a wall sometimes thin, sometimes very thick, giving all the reactions of callose. In this form the fructifications are identical with the oospores of the *Peronosporas*.

Thus defined by its very delicate cellulose mycelium, which recalls that of the *Mucorineae*, by its fructifications similar to those of the *Peronosporae*, the parasite which destroys the mycorrhiza of chestnut trees appears to me to constitute a new genus in the group of the *Oomycetes*; I designate it under the name *Mycelophagus castaneae* (Mangin).

Hab. in different parts of France.]



OVULARIA SYRINGAE Berkeley in Gard. Chron., Ser. 2, 16, p. 665, fig. 135, 19 November 1881.

Floccis ut plurimum decumbentibus, acrosporis primum subglobosis papilla terminali, dein ellipticis, demum ovatis maximis.

[Flocci for the most part decumbent, acrospores at first nearly globose, with a distinct terminal papilla, then elliptic, at length ovate, very large; on Lilac, Aberdeenshire.]

The acrospores are much larger than those of the potato mould (Peronospora infestans). . . . The length of the decumbent threads is 0.012 inch; that of the acrospores 1.002 [?0.002] -0.003 inch.

PERONOSPORA FINTELMANII Caspary in Verh. Ver. Gartenb. Berlin, 21, p. 327, 1852.

[Cited as a synonym of Peronospora infestans by Caspary in Verh. Preuss. Akad. Wiss. Berlin, 3, p. 325, May 1855.]

PERONOSPORA SEMPERVIVI Schenk in S. B. naturf. Ges. Lpz., 2, 7, pp. 70-73, July 1875; reprinted in Bot. Ztg., 33, 42, p. 691, 15th October 1875.

[Usually given as a synonym of Phytophthora cactorum.]

Das Mycel breitet sich in den Interzellulargängen des Rindengewebes aus und füllt diese vollständig. Haustorien sind an ihm verhältnissmässig wenig entwickelt, sie sind dichotom verzweigt, wenn sie vorhanden sind. . . . In den Athemhöhlen der Spaltöffnungen bildet das Mycel kleine Knäuel, aus welchen die die Conidien tragenden Aeste sich abzweigen, seltener sind es einzelne Myceläste, welche die Conidien erzeugen. In der Regel treten die die Conidien tragenden Aeste aus den Spaltöffnungen einzeln oder zu mehreren, bis zu acht, hervor; . . .

Die die Conidien tragenden Aeste sind einfach, unverzweigt. . . . Bei längerer Cultur auf dem Objectträger treten auch verzweigte Conidienträger neben den unverzweigten auf.

Die Conidien sind eiförmig mit kurzer stumpfer Spitze am Scheitel und einem aus der verdickten Scheidewand gebildeten kurzen Stiel an der Basis versehen. Die kleinsten derselben sind 5, die grössten 36 Theilstriche meines Zeiss'chen Mikrometers lang und 4 bis 25 Theilstriche breit. Bei der vollständigen Reife treten aus ihnen Schwärmsporen aus, welche in derselben Weise wie bei Peronospora infestans Mont. entstehen, deren Zahl nach der Grösse der Conidien verschieden ist, in den kleineren entstehen 4 bis 8, in den grösseren steigt die Zahl derselben bis zu 32.

.....
Kurze Zeit nach dem Auftreten der Conidien, und während diese ihrer Ausbildung entgegengehen, erscheinen in dem Gewebe der Rinde und in den Haaren auch die Oogonium mit den Antheridien. Ihre Entwicklung bietet keine Erscheinungen, welche von den bereits durch die Bary festgestellten wesentlich abweiche. Die Antheridien habe ich stets an der Basis des Oogoniums mit ihrem feinen schnabelartigen Fortsatz eindringen sehen, ihr Inhalt tritt langsam bis auf wenige Fetttropfen in das Ei (Oospore) über. Die Cellulosemembran des befruchteten Eies verdickt sich, ist aber auch bei dem reifen Ei and der Aussenfläche glatt, von hellbraun Farbe.

Das Vorkommen und die Veränderungen, welche diese Peronospora auf den von ihr befallenen Pflanzen hervorruft, erinnert an die von Cohn (Beiträge zur Biologie der Pflanzen; Heft I, pag. 51 ff.) beschriebene P. cactorum. Indess sind beide, wenn auch die Form der Conidien sehr übereinstimmt, doch durch die normale Entwicklung der Conidien und ihrer Träger verschieden, vorzüglich aber auch dadurch, dass P. cactorum Schwärmer bildet.

An die Sempervivum arten S. album, S. tectorum, S. glaucum, und S. stenopetalum.

[The mycelium spreads out in the intercellular spaces of the bark tissue and fills it completely. Haustoria are formed on it relatively scarcely, they are dichotomously branched, when they are present. . . .

In the air spaces of the stomata the mycelium forms small knots, from which the conidia-bearing branches grow out, seldom single mycelial branches, giving rise to conidia. As a rule the conidiophores appear from the stomata singly or more, up to eight. . . .

The conidiophores are simple and unbranched. . . after longer culture on a

slide branched conidiophores will also appear beside the unbranched ones.

The conidia are oval with a short blunt tip at the apex and a short stalk, formed from the thickened septum, at the base. The smallest of these are 5, the largest 36 subdivisions of my Zeiss micrometer in length and 4 to 25 subdivisions broad. At complete maturity swarm spores emerge from them, which arise in the same way as those of *Peronospora infestans* Mont., and the number of these varies according to the size of the conidium; the smaller ones contain 4 to 8, in the larger ones the number may rise to 32.

A short time after the appearance of the conidia and during the time they develop, there appear in the tissues of the bark, and in the hairs also, oogonia with antheridia. Their development shows no features essentially different from those observed by de Bary. I have always seen the antheridium at the base of the oogonium with a fine beak-like process penetrating it, its contents, save for a few oil drops, pass over into the egg (oospore). The cellulose wall of the fertilized oospore is thick but in the ripe oospore is also smooth on the outer surface and of a light brown colour.

The occurrence and the changes which this *Peronospora* produces in the plants attacked by it reminds one of *P. cactorum* described by Cohn. Though the shape of the conidium is closely similar, both are distinguished nevertheless by the normal development of the conidium and its conidiophore, but also, chiefly, that *P. cactorum* forms swarmers.]

PERONOSPORA TRIFURCATA Unger in Bot. Ztg, 5, 18, p. 314, pl. VI (figs. 1-6) [given as 5-10 in the text], 30th April 1847.

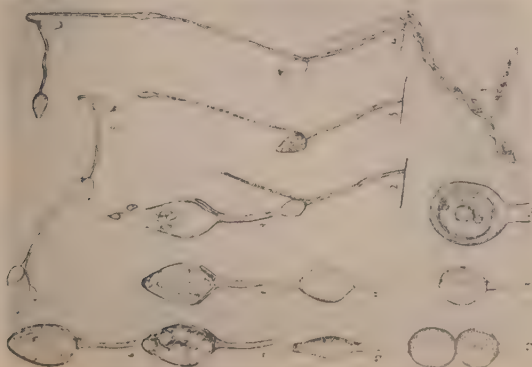
[Usually given as a synonym of *Phytophthora infestans*.]

P. stipitibus erectis paucis ex eodem puncto (e stomatibus) emergentibus, simplicibus, supra trifurcatis. Sporis magnis ovatis, apiculatis pedicellatisque glabris albidis nucleo grumuloso. Long. spor. 0.00104-0.00109 poll. paris., latitud. 0.0007-0.00076 poll. paris.

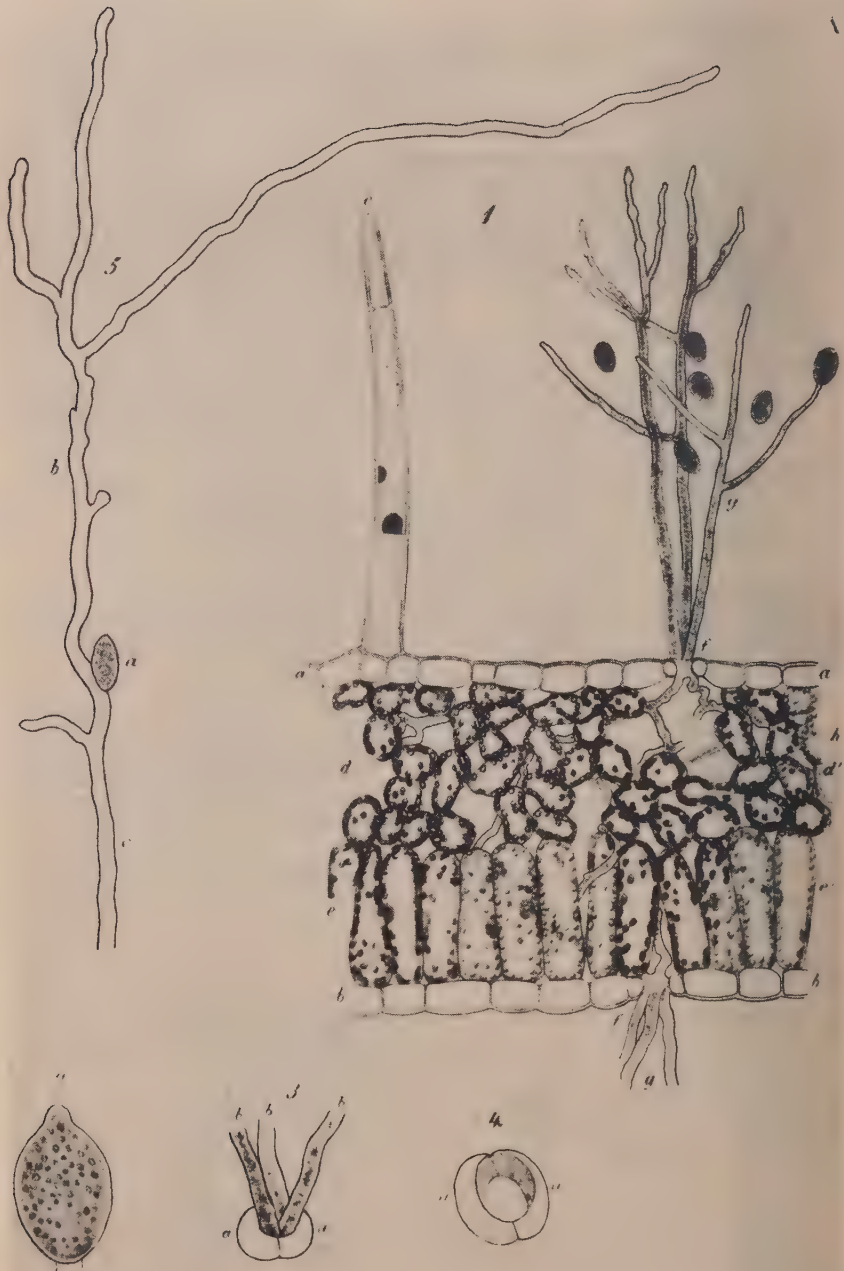
In foliis et caulibus vivi Solani tuberosi.

[Pilei stalked, erect, few emerging from the same point (from the stomata), simple, trifurcate above. Spores large ovate, apiculate and pedicellate, smooth, whitish, contents granular. Spores 0.00104-0.00109 Paris inches long, 0.0007-0.00076 Paris inches broad. One Paris inch = 27.9 mm.]

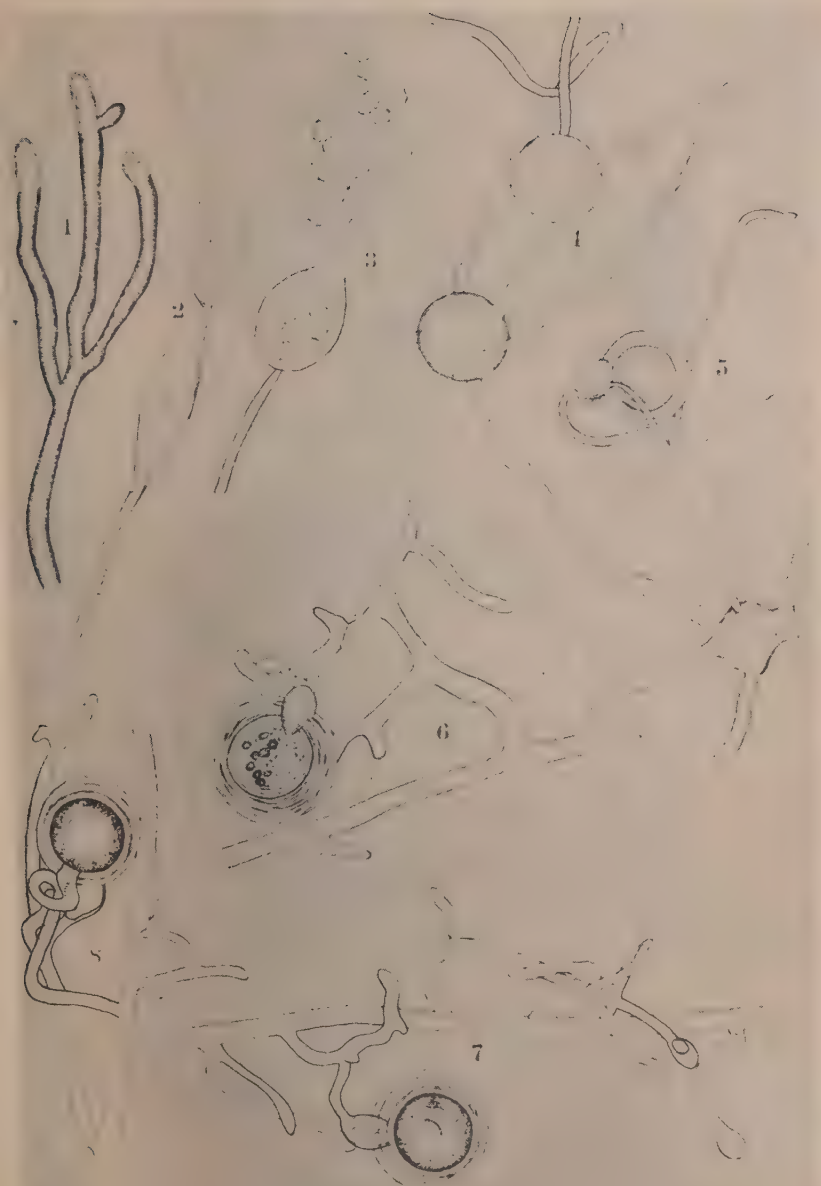
PYTHIOMORPHA FISCHERIANA Höhnk in Bot. Zbl., 55, A, p. 92, fig. II, 1936.



Pythiomorpha fischeriana — no magnification given



Peronospora trifurcata — no magnification given



Pythiomorpha miyabeana — figs. 1-8, $\times 430$

Mycelium in intramaticale et extramaticale compositum est. Mycelium intramaticale irregulariter formatum est et crassius quam mycelium extramaticale. Hoc regulariter cymosum tenue est diameter 3-5 μ . Zoosporangia diameter circa 28-46 μ .

Zoosporangia rumpente ut zoosporae exeunt. Zoosporae duobus ciliis lateralibus instructae diameter 10 μ .

Gemmae formarum differentium. Oogonia cum ovo singulari. Antheridia non observata. In ramulis dejectis *Alnus* spec.

[Mycelium is intramatrical or extramatrical. Intramatrical mycelium is irregularly formed and thicker than the extramatrical mycelium. This is regularly cymose, thin, diameter 3-5 μ . Zoosporangia diameter about 28-46

Zoosporangia bursting and zoospores come out. Zoospores with two cilia laterally arranged, diameter 10 μ . Gemmae of different forms. Oogonia with one egg. Antheridia not observed.

In fallen branches of *Alnus* sp.]

PYTHIOMORPHA MIYABEANA Ito & Nagai in *J. Fac. Agric. Hokkaido Univ.*, 32, 2, pp. 50-51, pl. VIII (figs. 1-8), December 1931.

Mycelia extra- and intra-matrical; hyphae non-septate, often more or less swollen in knob-like appearance at irregular intervals, 2.5-4.8 μ , mostly 3-3.5 μ in width. Sporangia lemon-shaped, broadest at the base, 36-53 $\times$ 17-36 μ , mostly 46-48 $\times$ 24-29 μ in size; later sporangia produced on the hyphae proliferated inwardly through the empty preceding ones. Zoospores ellipsoidal, 8.5-9.5 μ in diam., matured in the sporangium, swarming out directly. Oogonial stalks recurved or coiling, developed laterally on the main hyphae. Oogonia abundant, globular, dark yellowish at maturity, 28-50.5 μ diam., with an oospore; wall smooth, thin, unpitted, about 1.8 μ thick. Antheridial branches short, usually arising androgynously from the main hyphae or from the oogonial stalks. Antheridia clavate or oblong, attached by the apices to the oogonial wall. Oospores globular, smooth, 24-36 μ in diam. Gemmae globular or somewhat irregular in shape, intercalary, nearly equal to the oogonia in size.

Hab. On rice-seedlings in the paddy rice-field in Hokkaido and Honshu, Japan, and Korea.

PYTHIOMORPHA ORYZAE Ito & Nagai in *J. Fac. Agric. Hokkaido Univ.*, 32, 2, p. 51, pl. VIII (fig. 9), pl. IX (figs. 1-6), December 1931.

Mycelia extra- and intra-matrical; hyphae non-septate, branched monopodially, often swollen in knob-like appearance at irregular intervals, 3.5-11 μ , mostly 6-8 μ in width. Sporangia ovoid, ellipsoidal or somewhat elongated, 41-84 $\times$ 26-48 μ , mostly 60-84 $\times$ 29-43 μ in size; later sporangia produced on the hyphae proliferated inwardly through the empty ones, or on the lateral branch from the base of them. Zoospores ellipsoidal or kidney-shaped, about 12 $\times$ 7 μ , matured in the sporangium, swarming out directly or discharged being wrapped with the vesicle-membrane which is soon broken off by the self-agitation of the zoospores, and then swarming away. Oogonia and antheridia absent. Gemmae globular or somewhat irregular in shape, intercalary. Hyphal clumps produced on corn-meal agar.

Hab. On rice-seedlings in the paddy rice-field in Hokkaido and Honshu, Japan.

PYTHIUM UNDULATUM Petersen in *Bot. Tidsskr.*, 29, 4, p. 394, fig. VIII, December 1909; reprinted in *Ann. Mycol.*, 8, 5, p. 531, October 1910.

Mycelium intramaticale difficile distinguendum. Mycelium extramaticale e hyphis non ramosis, longis, plus minus undulatis, diam. c. 3-6 μ , constat. Zoosporangia terminalia, ellipsoidea, interdum parva papilla apicali instructa, diam. c. 130 $\times$ 50 μ . Zoosporae duobus ciliis lateralibus munitae, diam. long.



Pythiomorpha oryzae — all figs. $\times 430$

15-20 μ , in vesica ut in *Pythio*, exeunt. Hyphae in et per zoosporangia evacuata penetrant et zoosporangia nova formant. Color membranae mycelii et zoosporangiorum leviter fuscus. Organa sexualia non observata. Frequens in laminis et petiolis (rarius gemmis) *Nymphaeae albae* et *Nuphar. lutei*.

It is difficult to trace the intramatrical mycelium; the extramatrical consists of long (often several millimetres), unbranched, more or less undulating hyphae. Terminal sporangia, seldom lateral. They open at the apex, sometimes with a papilla. The zoospores are similar to those in *Pythium*. When the zoospores have escaped sometimes new sporangia are formed within the old ones sometimes the hyphae may penetrate and not form any sporangia until later on. The protoplasm is refractive; the membranes of the hyphae and sporangia more or less brownish coloured. This species seems to live especially on decaying leaves and stems of *Nuphar* and *Nymphaea*. Occasionally I found it on old fruits of *Iris* and on branches of trees. Several localities in North Sealand and Jutland.

PYTHIOMORPHA UNDULATA (Petersen) Apinis in *Acta Hort. bot. Univ. latv.*, 4, pp. 234-235, fig. 4, 10th March 1930.

Hyphen 3-8 μ dick, ohne Einschnürungen, meist schwach verzweigt, in vom Sporangium entfernten Teilen mehr oder weniger unduliert. Membran der Hyphen ziemlich dick, hyalin, zuweilen schwach gelblich, oder schwach braunlich gefärbt, mit Chlorzinkjod sich nicht blauend. Gemmen fehlen. Sporangien länglich oval, 20-52 $\times$ 50-167 μ gross. Oft junge Sporangien in die alten ein- oder durchwachsend so dass die durchgewachsenen Sporangien zu 2-3 in einer Reihe angeordnet sind. Sporen 10-18 μ gross, mit zwei seitlichen Cilien. Nach dem Verlassen des Sporangiums incistieren sich die Sporen, häuten darauf und bilden nachdem den Keimschlauch. Unter Umständen incistieren sie sich im Sporangium und keimen daselbst. Organe der geschlechtlichen Fortpflanzung nicht mit Sicherheit beobachtet.

Auf Pflanzenresten und ausgelegten Äpfeln im Seen in Lettland, Mai 1927 und Juni 1928.

[Hyphae 3-8 μ wide, without constrictions, usually sparsely branched, more or less undulating in the parts distant from the sporangium. Hyphal wall fairly thick, hyaline, sometimes coloured slightly yellowish or slightly brownish with chlor zinc iodide, but not turning blue. Gemmae lacking. Sporangia longish oval, 20-52 $\times$ 50-167 μ in size. Often young sporangia grow into or through the older so that the proliferated sporangia are arranged 2 or 3 in a series. Spores 10-18 μ in size, with two lateral cilia. After their release from the sporangium the spores encyst, thereupon shedding a coat and afterwards forming a germ tube. Under certain circumstances they encyst in the sporangium and germinate there. Organs of sexual reproduction not observed with certainty.

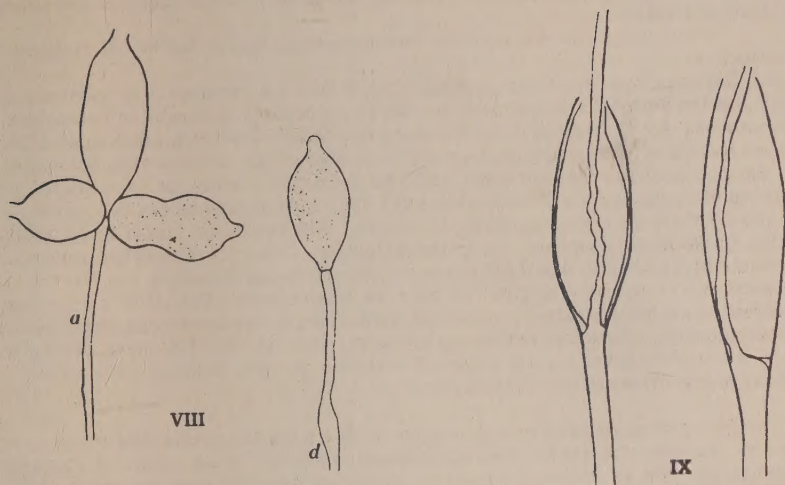
On plant remains and deposited apples in lakes in Latvia, May 1927 and June 1928.]

SCLEROSPORA KRIEGERIANA Magnus in *Verh. Ges. dtsch. Naturf. Ärzte*, 67, p. 100-102, 17th September 1895.

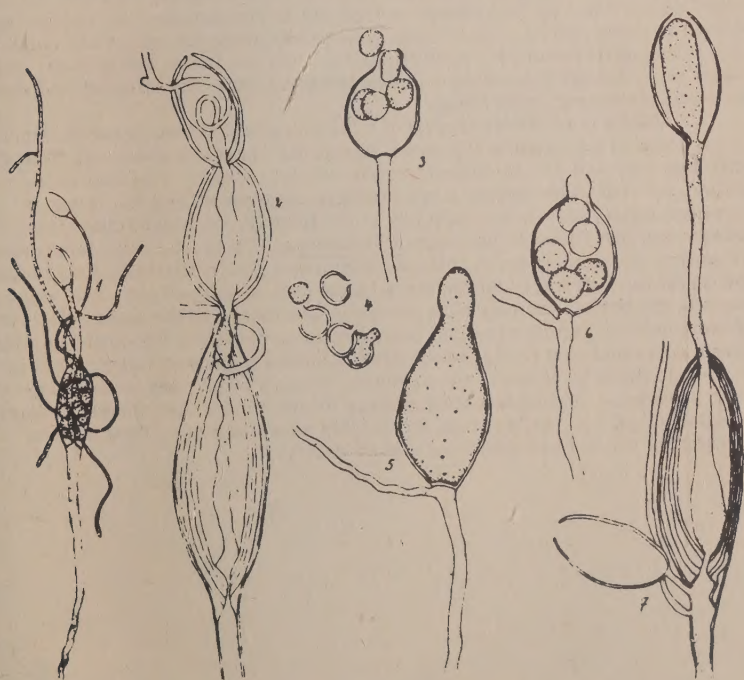
[Cited as a synonym of *Phytophthora macrospora* by Ito & Tanaka in *Ann. phytopath. Soc. Japan*, 10, 2-3, p. 135, December 1940.]

Vortragender sprach über eine neue Sclerospora, die der scharfsichtige Mykologe Herr W. Krieger bei Königstein in Sachsen in den Blättern von *Phalaris arundinacea* entdeckt hat. Auf einem gemeinschaftlich unternommenen botanischen Ausflage zeigte Herr Krieger Vortragendem den interessanten Pilz und überliess ihm denselben zur näheren Untersuchung. Vortragender erlaubt sich, diese neue Art *Sclerospora kriegieriana* zu nennen.

Es ist, wie das Mycel aller Peronosporreen, unseptisch und verläuft streng intercellular. Aber es ist sehr starkwandig und durch plötzliche mächtige Anschwellungen an zahlreichen Stellen sehr ausgezeichnet. Durch diese Anschwellungen



Pythium undulatum — fig. VIII, no magnification given; IX, $\times c. 165$



Pythiomorpha undulata — fig. 1, $\times 183$; 2-7, $\times 322$

drückt das Mycel die umgebenden des Gewebezellen asserordentlich bis zum Verschwinden des Lumens zusammen, und so kommt es, dass trotz des so stark entwickelten Mycels das behaftete Blatt keinerlei verdickung oder Anschwellung nach aussen zeigt.

..... Abweichend von den meisten Peronosporeen bildet das Mycel niemals Haustorien.....

Die Oogonien werden in der gewöhnlichen Weise als kugelige Anschwellungen eines kurzen Seiten-astes gebildet und durch anliegende Antheridien befruchtet. Die wandung der Oogonie und die Wandung der Oospore werden stark ausgebildet, und letztere liegt der ersteren dicht und fest überall an, worauf eben Schroeter die Gattung *Sclerospora* begründet hat. An der stark verdickten Aussenwand der Oogonie erkennt man die Eintrittsstelle des Befruchtungsfortsatzes des Antheridiums deutlich als wohlausgebildeten Tüpfel. Ein ähnlichen Tüpfel findet sich in der Wandung der Oogonie, wo er der Stielzelle aufsitzt. Wie schon vorher erwähnt, ziehen häufig Auszweigungen des Mycel in das zwischen den Nerven gelegene Parenchym die immer von engeren Lumen sind. Oft gehen solche Auszweigungen nach den Spaltöffnungen und treiben unter denselben charakteristische Auszweigungen. Zuweilen treten sie ein wenig aus den Spaltöffnungen hervor und sind, wie vorher erwähnt, als weisse Punkte von aussen sichtbar. Sie mögen rudimentär gebliebene Conidienträger sein.

[The lecturer spoke on a new *Sclerospora* which the sharp-sighted mycologist, Herr W. Krieger discovered near Königstein in Saxony in the leaves of *Phalaris arundinacea*. On an ordinary botanical excursion Herr Krieger showed the lecturer the interesting fungus and let him have it for more detailed examination. The speaker takes the liberty of naming this new species *Sclerospora kriegeriana*.

Like the mycelium of all Peronosporaceae it is non-septate and runs strictly intercellular. But it is very strong walled and is distinguished by sudden large swellings in many places. By means of these swellings the mycelium compresses the surrounding tissue cells extraordinarily, until the lumen disappears, and this explains why, despite the strongly developed mycelium, the infected leaf shows no external thickening or swelling.

..... Unlike most Peronosporaceae the mycelium never forms haustoria.

The oogonia are formed in the usual manner as spherical swellings on short lateral branches and are fertilized by adjacent antheridia. The wall of the oogonium and that of the oospore are strongly constructed and the latter is everywhere tightly and firmly attached to the former, on which [character] Schroeter has just founded the genus *Sclerospora*. On the strongly thickened outer wall of the oogonium the point of entrance of the fertilization tube of the antheridium can be clearly distinguished as a well-developed pit. A similar pit is found in the wall of the oogonium where it is attached to the stalk cell. As mentioned before, ramifications of the mycelium frequently penetrate into the interveinal parenchyma [cells] which always have a narrower lumen. Frequently such ramifications go towards the stomata, beneath which they develop characteristic branches. Sometimes they emerge slightly from the stomata and are, as mentioned before, visible from the outside as white dots. They may be conidiophores which have remained rudimentary.]

